Australasian Plant Conservation

BULLETIN OF THE AUSTRALIAN NETWORK FOR PLANT CONSERVATION Inc

VOLUME 21 NUMBER 2 • SEPTEMBER – NOVEMBER 2012

NatureLinks SA: landscape-scale conservation in action

Establishing native vegetation on the Mount Owen Mine Model Site

Biorich plantations: integrated commercial and environmental treescapes

Better bush for your buck: targeting restoration efforts and exploring restoration methods in the lower Hunter Valley, NSW

Buffer zones for aquatic biodiversity conservation

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SPECIAL THEME: LANDSCAPE RESTORATION

ANPC National Office

GPO Box 1777
Canberra, ACT 2601, Australia
Ph: (02) 6250 9509
Fax: (02) 6250 9528
Email: anpc@anpc.asn.au
Web: http://www.anpc.asn.au

National Office Staff

Tricia Hogbin and Merryl Bradley

Volunteers

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Australasian Plant Conservation

Editor

Selga Harrington

Editorial Team

Paul Adam, Phil Collier, Paul Donatiu,
Sally Jacka, Liz Myszka

Layout & Graphic Design

Siobhan Duffy

Australasian Plant Conservation is produced by the ANPC Inc. with assistance from the Australian National Botanic Gardens.

Australasian Plant Conservation is printed on recycled paper.
ISSN 1039-6500

New Zealand Plant Conservation Network

President Philippa Crisp
Secretary John Sawyer
PO Box 5086 Wellington, New Zealand.
Email: info@nzpcn.org.nz
Web: www.nzpcn.org.nz

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Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research, and diary dates are welcome. **The deadline for the December 2012 – February 2013 issue is Friday 9 November 2012.** The issue will contain papers from the ANPC 9th National Conference. General articles are also very welcome. Specific examples of effective monitoring and general articles are also very welcome. Please contact Selga Harrington if you are intending to submit an article: selga.harrington@gmail.com.

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Front cover: Fire triggered serotinous burn piles in flame within contour graded seams. Image: Justin Jonson. From the article *Restoring patches: landscape restoration in practice* by Justin Jonson.

Printed by: Trendsetting, Canberra.

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From the editor

Selga Harrington

Parsons Brinckerhoff

Welcome, readers, to the spring edition of Australasian Plant Conservation. Following on from our previous edition of APC on the theme of bushland restoration, this edition examines restoration at the larger landscape scale. Landscape restoration aims to conserve biodiversity, to regain ecological integrity and assist with recovery of degraded ecosystems by focusing on restoring ecological processes to achieve this.

Loss and degradation of habitat is a major cause of decline and extinction of species in Australia. The extent and scale of degradation poses many challenges to recovery efforts. In this edition we look at the continental, statewide and regional planning strategies that have been used to identify and plan where landscape restoration would be most beneficial and how to empower and assist local groups to undertake their projects. We also look in detail at some practical on-ground works being undertaken to restore landscapes including mine sites, degraded farmland and former construction sites. These projects provide valuable lessons and techniques to restore native vegetation and habitats. In some of these projects this also includes balancing restoration with maintaining viable farming or forestry operations, thus providing real life examples of how farmers and land managers can balance conservation and economic needs.

Following the themed articles we have some interesting general articles. The first is an article on buffer zones for aquatic biodiversity conservation and their use for biodiversity protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The second, an article on pollination biology of Western Australia's Showy Everlasting Daisy (*Schoenia filifolia* subsp. *subulifolia*) and finally, an article on dieback of Macquarie Island Cushion plant, (*Azorella macquariensis*) and the efforts underway to try and reverse its decline.

The issue concludes with our regular features: Report from New Zealand Plant Conservation Network; Book reviews, Information resources and useful websites, Research Roundup and upcoming Conferences and Workshops.

I hope you enjoy this edition and our upcoming conference in Canberra (29 October to 2 November 2012). For those unable to attend, we'll be able to share some of the conference papers with you in our next edition of APC. Until then, happy reading!

NatureLinks: landscape-scale conservation in action

Stella Kondylas and Andrew Schurgott

Department of Environment, Water and Natural Resources, South Australia.
Email: Stella.Kondylas@sa.gov.au, Andrew.Schurgott@sa.gov.au

NatureLinks in South Australia

In response to ongoing biodiversity loss and the emerging threat of climate change, the South Australian government has adopted a landscape-scale approach to conservation across the state.

The approach is based on The Wilderness Society's Wild Country vision and the idea that conservation of biodiversity and natural habitats demands a landscape-wide approach that recognises the importance of ecological connectivity at continental and regional scales.

NatureLinks was established as a policy initiative in 2002 at the then Department of Environment and Heritage. It was based on a vision for an ecologically sustainable future: In one hundred years South Australia would have five landscape-scale conservation areas of connected habitat consisting of a comprehensive system of core protected areas, incorporating our national parks and reserves, buffered and linked by areas of land and sea managed for conservation. Within these areas South Australian species and ecosystems would be able to survive, evolve and adapt to environmental challenges such as climate change.

In 2004 this landscape approach was incorporated into the state's strategic plan through the goal of having five well-established biodiversity corridors aimed at maximising ecological outcomes. We use the term corridor to define large areas of similar ecosystems that will benefit from focused and coordinated restoration to create more and better habitat. In this sense the corridors are about coordinated human effort, and bringing different groups together, from private land managers to communities and government, to deliver conservation projects.

The NatureLinks program is managed by the Department of Environment, Water and Natural Resources (DEWNR) through a centrally-based project manager and coordinators focused on each corridor. NatureLinks is not a 'hands-on' program, but could be seen as an umbrella that connects land managers, organisations, community groups and government agencies around conservation projects. Partnerships are at the core of the program even extending to the management level, where NGOs are working in partnership with DEWNR on key state-wide issues including communications and governance.

Today NatureLinks is based around these five biodiversity corridors, along with a sixth corridor, the 3,500 kilometre Trans-Australia Eco-Link, running through the centre of the continent to the Northern Territory.

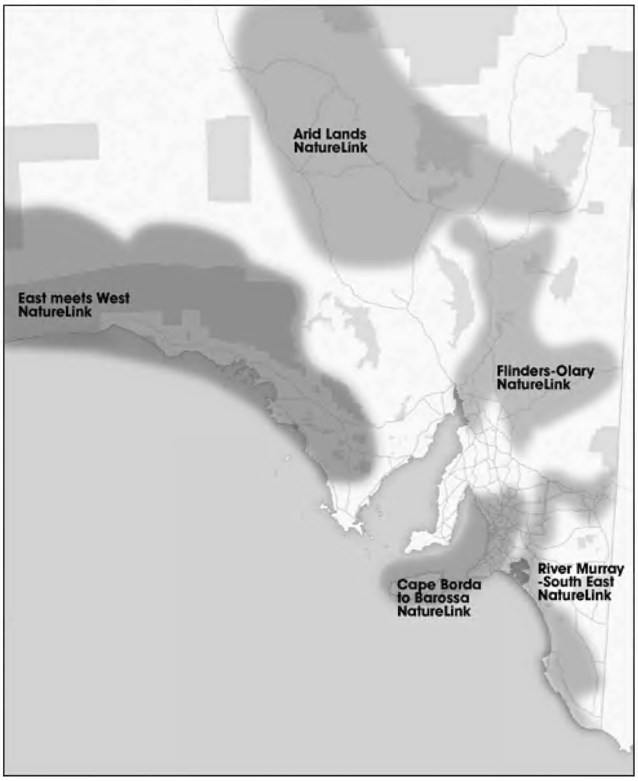
NatureLinks Projects

NatureLinks projects encompass the broad spectrum of conservation activities, as well as initiatives focused on landholders such as feral animal control programs and identifying biodiversity assets. While each project is different, they are all guided by some broad principles:

- *Landscape scale:* projects apply a long-term, landscape-scale approach to conservation activities that operate across public and private land at both local and regional levels.
- *Locally connected:* projects focus on building local ownership for conservation by facilitating cooperation between land managers, traditional owners, communities, organisations and government.
- *Knowledge based:* projects ensure that the best available scientific, traditional and local knowledge is shared between partners, to help plan, evaluate and guide conservation work.

It is also quite an important distinction that projects are not 'owned' by NatureLinks or DEWNR, but are run independently, usually between several partners, some of which may be state government agencies. This is an important distinction to the people on the ground that have developed the projects and is a key factor in local ownership and connecting with grassroots efforts.

Another important note on projects is that there is not a one-size-fits-all approach. Not only are project governance and funding models different, but each project is focused on its unique environment. For example, on the Eyre Peninsula


Arid Lands NatureLink
East meets West NatureLink
Flinders-Olary NatureLink
River Murray -South East NatureLink
Cape Borda to Barossa NatureLink

NatureLinks corridor locations. Map: Department of Environment, Water and Natural Resources

NatureLinks Corridors

- *Arid Lands NatureLink*: encompasses the stony plains and inland lakes in the centre and north of the state, including Marree and Marla.
- *Cape Borda to Barossa NatureLink*: from the western edge of Kangaroo Island, north-east across Backstairs Passage, and north through the Adelaide region to the Barossa Valley.
- *East meets West NatureLink*: from central Eyre Peninsula to the Western Australian border, including the Nullarbor Plain and the Great Australian Bight.
- *Flinders-Olary NatureLink*: starting in the southern Flinders Ranges and extending north to the Flinders and Gammon Ranges, and north-east to the Olary Ranges.
- *River Murray-South East NatureLink*: stretching the full length of the River Murray in South Australia, encompassing the entire Coorong area and continuing along the south eastern coast to the Victorian border.
- *Trans-Australia Eco-Link*: the world's first transcontinental wildlife corridor, connecting the Northern Territory's Territory Eco-link with the Arid Lands and Flinders-Olary NatureLinks in South Australia.

in the far west of South Australia the focus is on how to manage, protect and restore existing habitats, while in the south-east of the state, a landscape that was once endless wetlands has changed so dramatically that the starting point is restoring water flows to rebuild the wetlands.

Most project implementation occurs through grant funds provided by the South Australian and Australian governments, and to a lesser extent non-government grant bodies. Recently the Australian Government committed to significant investment within NatureLinks areas through the Biodiversity Fund, focused on restoring existing habitats, managing invasive species and revegetating previously cleared landscapes.

Case Study: Kangaroo Island Nationally Threatened Plant Project

A NatureLinks project that illustrates some of the innovative work taking place in landscape-scale restoration is the Kangaroo Island Nationally Threatened Plant Project.

Kangaroo Island (KI to locals) is Australia's third largest island located just over 100 kilometres from Adelaide off the tip of the Fleurieu Peninsula. The island retains around 47% of its remnant vegetation (more than half of which is within protected areas), although the eastern third of the island has less than 15% remnant vegetation and suffers from significant habitat decline and fragmentation.

Threats to Kangaroo Island's endangered plant species have included declining habitat, weed infestations, inappropriate fire regimes and grazing. The threatened plant project implements a recovery plan to address these issues for 15 nationally threatened plant species, with the aim of reinstating large patches of habitat next to important areas of remnant bushland.

*The NatureLinks threatened plant project on Kangaroo Island aims to reinstate large patches of habitat next to important areas of remnant bushland for species at risk of extinction including the Kangaroo Island Phebalium (*Leionema equestre*).Photo: Michelle Haby*

Project work is based on comprehensive research into the composition of local plant communities and aims to mimic the diversity found in intact remnants by propagating and planting out a minimum of 120 species in biodiverse plantings. Five species at risk of extinction are given particular attention: Kangaroo Island Phebalium (*Leionema equestre*), MacGillivray Spyridium (*Spyridium eriocephalum* var. *glabrisepalum*), Small Flower Daisy-bush (*Olearia microdisca*), Kangaroo Island Turpentine Bush (*Beyeria subtecta*) and Kangaroo Island Pomaderris (*Pomaderris halmaturina* subsp. *halmaturina*).

To find the most effective way of helping nature do its work, an array of planting methods have been trialed, including direct seeding, direct planting and topsoil spreading. Removal of weed competition is also an important part of the project.

The project has been one of the first in South Australia to actively trial the use of fire to promote bushland recovery. Each burn site is monitored to examine vegetation community health in areas with different fire regimes.

Since 2004 on-ground planting activities have focused on a former farming property in the Cygnet River Valley. The Cygnet Park property is privately owned by the Nature Foundation of SA and two private investors. The project utilises volunteers each year to plant a variety of species. A Planting Festival has been held annually since 2007, and has resulted in 400,000 seedlings from 145 different plant species planted over more than 200 hectares. The 2011 festival saw 702 volunteers plant 120,000 plants across 53 hectares, a rate of around 7,000 seedlings per hour.

Like other NatureLinks projects, successful delivery has relied on coordination between a range of partners. The KI project's partners include the property owners, community volunteers, the KI threatened plant recovery team, DEWNR, the KI Natural Resources Management Board, Australian Government, Nature Foundation SA, BioR, Conservation Volunteers Australia, Kangaroo Island Community Education, Gardening Australia, Adelaide Zoo, Adelaide Botanic Gardens, Urrbrae High School, University of South Australia, UniLife, Adelaide University and Eco-Action KI. Funding has been sourced through the Caring for our Country program as well as the Native Vegetation Council and other state funding.

The next phase of the project will build on achievements to date, by continuing to reinstate high diversity threatened plant habitat across other private properties on the eastern end of the island.

Work will focus on re-instating, buffering, enlarging and connecting habitat supporting Kangaroo Island Narrow-leaved Mallee (*Eucalyptus cneorifolia*) plant communities. The mallee complex has been nominated for listing as a Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999.*

Better bush for your buck: targeting restoration efforts and exploring restoration methods in the lower Hunter Valley, NSW

Tricia Hogbin

Office of Environment and Heritage, Newcastle, NSW. Email tricia.hogbin@environment.nsw.gov.au

The native vegetation of the lower Hunter Valley has been extensively cleared since European settlement, with less than 30% remaining. The remaining vegetation is highly fragmented and subject to a range of threatening processes including continued clearing for residential and industrial development and habitat degradation.

Like many highly fragmented landscapes, it is clear that strategic restoration is needed to improve connectivity across the landscape. However, with limited funds available, and a 70,000 hectare project area, it wasn't immediately obvious where restoration efforts should be targeted. In addition, almost all remnant vegetation within the project area, which spans the valley floor region of the Cessnock local government area, is recognised as threatened ecological communities under the NSW *Threatened Species Conservation Act 1995 (DECC 2008)*, making it important that any restoration efforts be more than a tree planting exercise.

Two ongoing projects are shedding light on where restoration efforts should be targeted in the landscape and the methods that should be used to increase likelihood of success: the Cessnock Biodiversity Management Plan and the Experimental Revegetation of Threatened Ecological Communities in the Lower Hunter project.

Cessnock Biodiversity Management Plan

The Cessnock Biodiversity Management Plan (Office of Environment and Heritage 2011) spatially identifies priority actions for threatened species recovery across the project area and was introduced in *Australasian Plant Conservation* 19(3) (Hogbin 2011). The plan has since been published as a poster and was distributed widely among the community and made available online (http://www.environment.nsw.gov.au/biodiversity/cessnockmgtplan.htm). The reverse of the poster displays images for all 65 threatened entities occurring within the region.

The objective of the plan is to address the conservation needs of all 65 threatened entities occurring within the project area. Five key landscape corridors were identified based on the location of areas identified as a high priority for conservation. Areas of cleared vegetation within the landscape conservation corridors are identified as providing opportunities for revegetation. Restoration works within these targeted areas will likely contribute to the overall conservation of threatened entities and to landscape function more so than restoration outside of these targeted areas.

Experimental revegetation of endangered ecological communities in the Lower Hunter

This collaborative project with the University of Newcastle's Centre for Sustainable Ecosystem Restoration aims to build capacity and understanding of how to most effectively restore threatened ecological communities in the Lower Hunter (University of Newcastle 2010). The project is large scale experimental restoration of the threatened ecological communities Kurri Sand Swamp Woodland and Lower Hunter Spotted Gum-Ironbark Forest in cleared pasture. The influence of a range of variables on restoration success is being studied, including scalping, ripping, direct seeding, tube-stock planting, and application of soil ameliorants.

The project will need to be monitored over the long-term to truly appreciate whether or not we can effectively restore threatened ecological communities. However, results for the establishment phase of the trials are already providing insight into how to improve chances of restoration success. For example, results to date indicate that both scalping and ripping can increase emergence and survival for some species (University of Newcastle 2010). Scalping presumably increases survival due to reduced competition

The Cessnock Biodiversity Management Plan was published as a poster in an attempt to highlight key objectives and facilitate implementation of the plan by landholders, community groups, schools and other government agencies. Photo: Tricia Hogbin from the grass layer for light, water and nutrients and the positive ripping effect is presumably a consequence of ripping de-compacting the soil, leading to greater water, air and root penetration.

A detailed cost-benefit analysis was undertaken to gain greater insight into the cost and value of each variable. This information will help develop realistic budgets for future restoration projects. For example, overall the most expensive components of the restoration were the collection and cleaning of seed (for both direct seeding and tube-stock propagation) and site earthworks. Scalping was the most time intensive and therefore costly of the earthworks, while ripping did not substantially increase costs. The cost of revegetation at a density of ≥ 3150 plants per ha ranged from c. $6,500 for seeded, not scalped and not ripped plots to approximately. $12,000 for planted & seeded plots that were ripped and ameliorated with lime and dolomite.

An experimental restoration plot for the threatened ecological community Lower Hunter Spotted Gum-Ironbark Forest approximately two years after revegetation. One of the more effective treatments that involved scalping and ripping can be seen on the right. Photo: Tricia Hogbin

Conclusion

We now have a good understanding of where to target restoration efforts; the methods needed to increase the likelihood of success; and the likely cost of implementing these methods. The next stage in the project is to facilitate implementation. The Hunter-Central Rivers Catchment Management Authority is already undertaking habitat protection and restoration within one of the identified landscape corridors. A multi-partner project, bringing together a range of stakeholders including state and local government, community and landholders is currently being developed to seek funding to implement habitat restoration and protection across the broader project area.

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Establishing native vegetation on the Mount Owen Mine model site

Yvonne Nussbaumer, Carmen Castor and Mike Cole

Centre for Sustainable Ecosystem Restoration (CSER), The University of Newcastle, NSW
Email: Yvonne.Nussbaumer@newcastle.edu.au

The Hunter Valley

Together with agriculture, coal mining has substantially altered the landscape of the Hunter Valley in NSW. It is estimated that since European settlement, 76% of the vegetation communities in the Central Hunter Valley have been depleted and fragmented. This isolates local flora and fauna populations, leading to inbreeding, and potentially, population collapse. Creating corridors to re-connect vegetation remnants and augment them with restoration efforts is vital to their long-term survival and is an area in which mine rehabilitation efforts can play a significant role.

Development of the model site

A Model Site has been developed by the Centre for Sustainable Ecosystem Restoration (CSER) of the University of Newcastle at Mt Owen Mine with the support of Thiess P/L and Xstrata Coal. Mount Owen open-cut coal mine cleared 60% of the Ravensworth State Forest (RSF), a dry sclerophyll forest previously logged and grazed, leaving a large (northern) remnant and a small (southern) remnant. The spoil placement area for the mine is being progressively rehabilitated by forest or pasture topsoil being spread over the spoil with supplementary seeding or planting with tubestock. Offset areas which surround the mine are also being restored to woodland or forest ecosystems.

CSER research has extended into each of these areas with over 40 studies to date, and summaries of the research programs can be found on the CSER web site: www.newcastle.edu.au/research-centre/cser. Some key research insights are outlined below.

Pre-mining conditions

Most plants form symbiotic relationships with soil microbes (microscopic organisms, bacteria or fungi) which assist them in acquiring nutrients in exchange for carbon assimilated by the plant via photosynthesis. The soil bacteria rhizobia and *Frankia* fix nitrogen from the atmosphere, and supply it to wattles and peas or casuarinas. Endomycorrhizal fungi penetrate smaller soil pores, and ectomycorrhizal fungi can hydrolyse phosphorus from rocks and organic matter, thereby accessing nutrients not normally available to plant roots. However, many soils have a low capacity to form these root-microbe associations as a result of previous land use. Thus mine rehabilitation and offset restoration efforts are traditionally heavily reliant on the use of fertiliser. By re-establishing the root-microbe associations that provide sustainable nutrient acquisition, fertiliser use can be reduced.

The 'moonscape' of the Mount Owen spoil placement area and 8.5 years later. Photos: CSER.

Sampling has shown that organic carbon levels in Hunter Valley soils is low. Soil carbon is crucial for healthy, functional soils, as it supports soil microbial populations, increases water holding capacity and soil structure, and decreases soil dispersive properties. Increasing soil carbon will therefore make reconstructed systems more sustainable and resilient to environmental stresses such as drought.

Reconstructing functional soil - the importance of microbes

The spores of some soil microbes remain even in degraded ecosystems, such as in RSF, and when decompacted can have a high capacity for forming symbiotic associations with plant roots. However, if excessive fertiliser rates are applied to topsoil spread on spoil placement areas, the root-associations are unlikely to form and this can severely reduce the soil's potential for sustainable plant nutrition.

Mine spoil has very poor structure, but small spoil particles can be aggregated by plants and mycorrhizal fungi in the presence of an appropriate form of organic carbon, to form larger particles. This increases water, air and root penetration in the spoil. At least 3% organic carbon is required for this aggregation (Daynes *et al*., 2010).

Specificity between local plant species and rhizobia bacteria strains has been identified. Given the right combination, plants inoculated with rhizobia bacteria have been shown to grow better.

CSER has been developing a collection, and identifying, a range of native rhizobia from the Hunter Valley that can be cultured and reintroduced. Similarly, root cultures of mycorrhizal fungi are being maintained from a number of sites.

Topsoil transfer

Using topsoil from the target community (when available) is the best means of restoring a native vegetation community due to the seed bank and soil microbes it contributes. Some supplementary seeding may still be necessary to produce a full complement of vegetation strata. At Mount Owen Mine almost half of the native species found in the RSF have successfully grown on the spoil placement area primarily through the transfer of forest topsoil and associated seed bank.

Transferring forest topsoil to restoration lands is a cost-effective means of introducing native forest species, depending on the availability of sufficient quantities of forest topsoil, the size of the areas to be treated and the transport distance. Some evidence of dispersal from such sources into surrounding grassland has been found.

Amelioration methods

The following methods have been successful at Mount Owen Mine:

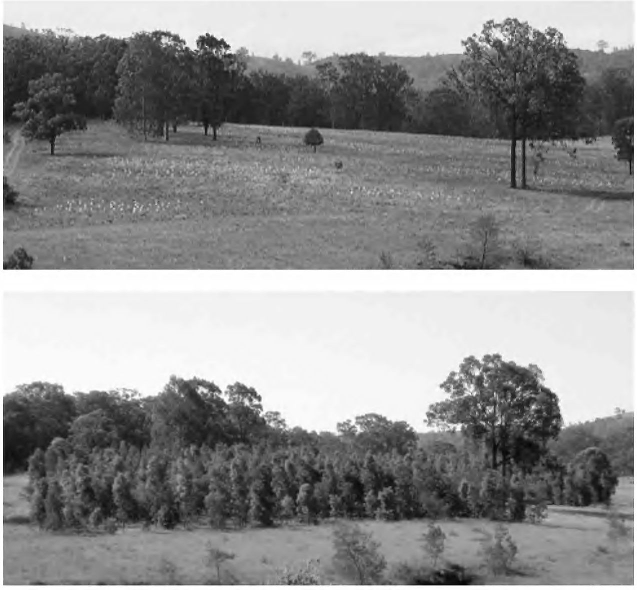
- Clay subsoil was found to be a good topsoil replacement. It increased native plant establishment, native species richness, plant growth and second-generation seedling establishment. Subsoils need to be characterised before use so as not to use dispersive material.
- Contour ripping the soil significantly increased plant survival and growth by decreasing soil compaction and therefore increasing water infiltration in both spoil placement areas and restoration lands. Ripping topsoil spread over spoil rehabilitation areas needs to be done soon after spreading to avoid losing plants that germinate from the seed bank. In areas where ripping is not possible, planting is best done in autumn when there is less water stress for plant establishment.
- While biosolids have been shown to have the capacity to boost native tree growth, the accompanying weed and grass growth out-competed native species when directly seeded.
- Municipal waste compost increased growth of Spotted Gum (*Corymbia maculata*) in spoil, with no negative impacts on photosynthesis. However, not all tested species responded equally well.
- Tree guards were particularly important for understorey and rainforest species survival and growth.

Weed control

Weed and grass propagules in some soils can produce excessive competition. In such instances it was better to seed directly on to spoil, plant tubestock or use a topsoil substitute, such as subsoil, rather than use weed-infested topsoil.

Weedy pasture topsoil can be capped with a weed-free material such as subsoil or reject material produced in the coal washing process (chitter) to suppress weeds and allow direct seeded native species to become established. In this scenario shallow, rather than deep ripping, scarifies the surface to reduce crusting and erosion, without re-exposing the underlying topsoil and stimulating the weed seed bank.

Scalping off the top 10 cm of topsoil in restoration lands was effective in removing the weeds and grasses and a large part of their seed bank, producing a higher native plant density from direct seeding than in un-scalped plots.



Experiment trialing the use of tree guards, fertilizer, watering and ripping in restoration lands at time of planting and 5 years later. Photos: CSER.

Seed dispersal and establishment of native plants into adjoining pasture areas was found to be poor in some areas. The seed bank was also dominated by exotic species. Active regeneration practices are therefore required to reconstruct native communities in these areas.

Acacia saligna has been shown to produce allelopathic chemicals that inhibit the growth of some native species. It is also promiscuous in its interactions with rhizobial symbionts, giving it an advantage wherever rhizobia are present. Cutting mature plants down and painting the cut stems with herbicide to prevent re-shooting has allowed good growth of planted canopy species that will eventually compete with *A. saligna* emerging from the seed bank.

Long-term research and monitoring

Long-term monitoring of spoil placement areas or restoration lands can provide evidence of resilience and long-term sustainability, e.g. following fire and drought. On-going research will contribute to the understanding of reconstructing ecosystems, allowing better outcomes to be achieved through adaptive management.

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Habitat reconstruction at Gunnedah Research Centre, Gunnedah. New South Wales

John Lemon[1], Warren Martin[1], Brian Wilson[2], Chris Nadolny[1] and Daniel Lunney[1]

[1] NSW Office of Environment and Heritage, [2] University of New England & NSW Office of Environment and Heritage.
Email: John.Lemon@environment.nsw.gov.au

Introduction

In 1943 the NSW Soil Conservation Service purchased a 214 ha property 6 km south of Gunnedah to demonstrate how severely degraded and eroded farmland could be rehabilitated using soil conservation earthworks and improved farming methods. The level of degradation was so severe that one significant rainfall event resulted in the adjacent main rail line being blocked by soil eroded from the property.

The Gunnedah Research Centre (the Centre) has evolved from its initial tenure as a farming property in 1905 to the present day property which has been used for research as well as production of wool, fat lambs, cattle and grain. Since 1991 a series of habitat reconstruction trials has been undertaken. At present the 90 ha of available grazing country has 20 ha of habitat reconstruction sites, with the remaining 70 ha planted with a combination of native and semi-tropical perennial grass pasture. The remainder of the property consists of steep hills of the Porcupine Range where the native vegetation has been left to regenerate naturally.

Background

In December 1988, it was evident that many of the River Red Gums (*Eucalyptus camaldulensis*), had been severely browsed by Koalas (*Phascolarctos cinereus*) resulting in a serious decline in tree health. Replacement trees were planted along the fence lines but it was soon realised that more needed to be done.

In 1991, a 1 ha direct seeding trial was initiated using one kilogram of mixed native species, including 635 g of *Eucalyptus* species - approximately 200 000 seeds - but only 12 trees became established. In 1993, the first of a sequence of habitat plantings using tubestock was commenced, as well as direct seeding understorey species. Additional plantings were undertaken in 1995, 1998, 2001, 2003, 2004 and 2005. It is intended to establish an additional 10 ha of plantings to connect the present sites to native vegetation on the Porcupine Range.

Lessons learned

From the initial direct seeding trial in 1991, it was soon realised that the smaller seeds such as *Eucalyptus* were difficult to establish locally, while the larger seeds, such as the acacias, were easier to establish. That is why tubestock are used for canopy species, and direct seeding for the establishment of understorey species. Key actions that have led to the successful establishment of the plantings include:

- excluding stock and fencing the area to be planted
- deep ripping the tree lines – try to do this when the soil is dry as that will shatter any compaction layer
- weed control – spray out rip lines to build up soil moisture 6 to 12 months prior to planting
- choosing a species mix that best fits the local plant communities – up to 16 different species have been used at the Centre, including larger trees as well as understorey species. The range of species chosen to suit the position in the landscape has been important for the survival of plantings during extended drought
- planting density and method is important and can vary depending on geographical location. In the sheep/wheat belt a maximum of 200 stems/ha, including both overstorey and understorey species, with spacing of 6 m between stems and 7 m between rows worked best
- post planting - water if needed, control weeds, and use hay mulch to suppress weed competition and to conserve soil moisture. If stock are to use the plantings they should be managed carefully and introduced for only short periods at a time.

These actions maximised the establishment success and growth rate of the vegetation, and also created a floristically diverse and structurally complex vegetation that has increased the habitat value for a range of fauna. Over time the ground cover has developed into a mosaic of leaf litter under and around the trees, and native grasses in the open spaces, benefiting a range of ground foraging birds. Fallen branches have created additional habitat complexity.

Common Dunnart captured in the 2001 plantings.
Photo: John Lemon

The habitat reconstruction sites have been used extensively as a demonstration site and for local field days, encouraging other landholders to undertake revegetation projects. More detailed information on the methods used at the Centre is contained in a Guide to successful tree establishment for environmental plantings which is available from the corresponding author on request.

Monitoring and research

Part of the success of the habitat reconstruction sites has been the inclusion of a number of research and monitoring activities. Prior to the establishment of these sites, baseline soil cores were taken to enable us to compare changes to soil health over time. Initial results showed that the plantings have resulted in improved soil organic matter and soil fertility (Wilson et al. 2002). Likewise, initial surveys of the groundcover vegetation showed that it is possible for a diversity of native grasses to recolonise sites that are planted with native vegetation (Nadolny and Lemon 2004).

Biodiversity audits were commenced in 1998 and have taken place each spring and autumn; most recently in April 2012. Many reptiles and frogs have been trapped using small mammal traps (Elliott traps) and pitfall traps. The House Mouse (*Mus musculus*) has invaded the sites but it was not until 1300 trap nights had been completed that, in autumn 2010, a male Common Dunnart (*Sminthopsis murina*) (a small, insectivorous marsupial about the size of a mouse) was captured. This was in the 9-year-old (2001) plantings, and Common Dunnarts have continued to be recorded in the 1998 and 2001 plantings.

Bird surveys were undertaken in 2000–2001 (Martin et al. 2004) and resurveyed in 2011–2012. Even during the surveys in 2000-2001, when the planted vegetation was only 3-8 years old, 55 bird species were recorded. Following the 2011-2012 surveys, an additional 11 species were recorded in the plantings and the numbers of birds (individuals per area) increased by nearly 40%. A number of threatened or declining birds have been recorded in the plantings: Glossy Black-Cockatoos (*Calyptorhynchus lathami*) were sighted in 2004 and 2008; Speckled Warblers (*Pyrrholaemus sagittatus*) and Painted Honeyeaters (*Grantiella picta*) have also been observed.

A tagged Koala in the 1993 plantings. Photo: John Lemon

Another positive outcome of the plantings is their utilisation by Koalas, as we discovered during a three year koala project (2008-2011) using radio-tracking collars, including GPS units which recorded Koala locations every 4 hours.

The value of this monitoring data for rehabilitation during and after major landscape changes, such as from mining, are now apparent (Lunney et al. 2012).

Conclusions

The major achievements of the Gunnedah Research Centre plantings are:

- the re-colonisation of the sites by native grass species
- the improvement in soil health
- the utilisation of the site by a range of animals, including threatened species
- the importation of additional native understorey species by birds after the seeds passed through their digestive system
- the ability to utilise the plantings for animal production and shelter.

The take home message from this research is that it is possible to achieve effective restoration outcomes, even on sites that have a long history of landscape degradation. It is possible to have a multiplicity of biodiversity, environmental and production benefits with careful planning and maintenance. The ability to use the sites for animal production and shelter, in addition to the environmental benefits, makes this an attractive package for landholders and other stakeholders. The lessons learned from the habitat reconstruction sites at the Centre have contributed towards the establishment of further revegetation sites across the sheep/wheat belt.

Acknowledgements

Our thanks to Philip Burrell, who was instrumental in setting up the initial biodiversity audits. Dr Ian Oliver provided comments on an earlier draft of this paper.

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Biorich plantations: integrated commercial and environmental treescapes

Ian Penna

Ballarat Region Treegrowers and University of Ballarat. Email: i.penna@ballarat.edu.au

Introduction

The idea of restoring landscapes in Australia leads to asking the question, 'What kind of landscapes do we want?' The Ballarat Region Treegrowers (BRT) considers that if people want to see the large-scale reintroduction of native vegetation cover in our countryside, then we need to also think about how the revegetation process might be able to contribute to revitalising social and economic landscapes. Broader social and economic benefits will support the long-term survival of the new ecosystems. BRT promotes the 'analogue' forest/biorich plantation model of revegetation because it can provide financial and environmental benefits to landowners.

BRT and 'biorich plantations'

BRT is the local branch of Australian Forest Growers, the national organisation representing private forestry interests. Since it was established in 1998, BRT has been promoting the integration of trees into agricultural areas for their potential socio-economic and environmental benefits to landowners and the wider community.

The term 'biorich plantation' was coined by BRT to represent the kind of tree/bush cover that could be created by applying the 'Blueprint for Sustainability Score Sheet' for landcare-type plantings developed by Teesdale nurseryman, Stephen Murphy (see Table 1). Stephen developed this index during the mid-late 1990s through his nursery and tree planting work. It provided a guiding 'blueprint' to overcome the deficiencies he saw in local landcare plantings.

The Score Sheet has 10 design principles grouped to address four issues important to the long-term ecological value of the plantings: Diversity, Structure, Species survival and Location. The physical and biological characteristics of a planting are weighted according to the points available for each design principle, so the higher the score, the more the planting is considered to have 'ecological value' and 'survivability'. A landholder can use the index to modify a planting design in relation to the restrictions or opportunities generated by the surrounding landscape and so maximise the planting's score and 'sustainability'.

BRT felt this sustainability index should be more widely recognised and commissioned Stephen to turn the underlying ideas into a book, which came to be titled *Recreating the Country* (Murphy, 2009). Given the group's interest in providing conservation plantings with a commercial value to make them more attractive to farmers, an important component of *Recreating the Country* was showing how commercial wood production could be integrated into the planning framework. Locally indigenous or exotic timber trees can be included in different ways to create biologically rich 'analogue' forests and woodlands that more closely resemble a native forest than a commercial wood plantation.

Analogue forests and biorich plantations

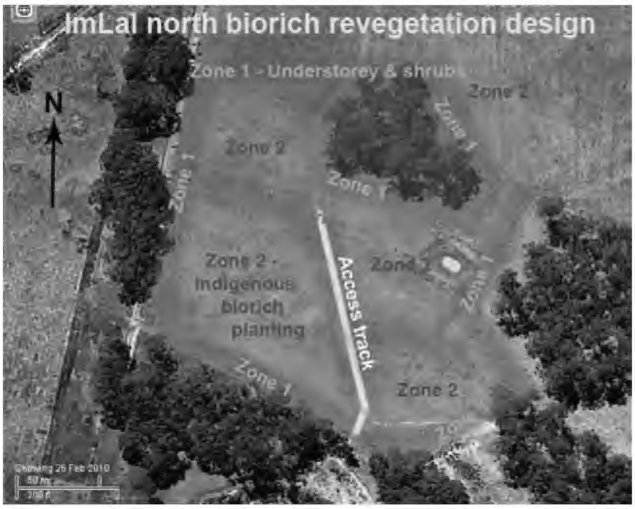
An 'analogue forest' is basically a human-created, tree-dominated ecosystem that is analogous in structure and function to a site's original climax or sub-climax forests. An analogue forest might be planted with species expected to be found in the forests of that area, or grown through 'seral stages' to reach a climax/sub-climax equivalent. However, in mimicking the role of the original forest and providing short- and long-term commercial value, analogue forests may use species exotic to that site (Duffy, undated).

"Analogue forestry is a response that seeks to address both the genetic and cultural issues of biological loss" (Senanayake and Jack, 1998). The concept was developed in Sri Lanka by modifying traditional village gardens. The originators wanted to tackle the social and environmental problems resulting from exploitative land management, including shifting cultivation and monocultural industrial agriculture. They wanted to recognise the value of lost ecosystems, restore productive capacity to the land, bring in genetic diversity, establish protective vegetation layers, and give local people more control over their way of life and natural resources – especially food and building materials.

The ImLal biorich plantation project

After publishing *Recreating the Country*, BRT decided to put words into practice and establish a model 'biorich plantation'. We received a Commonwealth 'Caring for Our Country' grant and the project was implemented with the cooperation of several public and private organisations.

Imreys Minerals Australia provided 10 hectares of land in the buffer zone around an old clay mine pit near the town of Lal Lal, southeast of Ballarat. Central Highlands Water contributed to the cost of the plants. Australian Forest Growers provided administrative support. BRT members and local volunteers planted the first 5 ha site in 2010 and the second 5 ha site in 2011.


ImLal north biorich revegetation design
Zone 1 - Understorey & shrubs
Zone 2
Zone 1
N
Zone 2
Zone 1
Zone 1
Zone 2 - Indigenous biorich planting
Access track
Zone 2
Zone 1
Zone 1
Zone 2

Basic design of second Imlal biorich plantation site. Source: Stephen Murphy

The plantings were designed by Stephen Murphy in conjunction with farm foresters in BRT. Both sites contain a diverse mix of species predominantly endemic to the area, with as many layers as possible – grasses and shrubs through to larger understorey and canopy trees. Plant species were clumped to help pollination and create vegetation layers. Natural regeneration of local species is encouraged. Some kind of 'environmental thinning' may occur to help express particular values.

Both sites contain a proportion of commercial timber trees in different layouts. The first site has 12 native forestry species in large clumps along an access track. Forestry trees are in strips along, and branching off, the access track of the second site, and Californian Redwoods were planted as part of a larger long-term trial. Only the forestry trees in both sites will be harvested for some wood products. They will be managed through pruning and thinning to produce fuelwood after a few years, then hopefully good quality sawlogs after some decades or longer.

Monitoring the plantation's growth and the changing fauna are important activities to help understand the changing relationships between the soil, water, plants and animals, and so direct management activities. Students from the University of Ballarat began monitoring plant growth and survival on the first site in late 2010, finding an 88% survival rate over the first year - aided by a very wet summer. In contrast, much of the second site will need replanting because of a dry summer and failed site preparation.

Twelve bird surveys have been conducted through the buffer zone and plantation sites since before planting in 2010, and more are planned. These surveys are led by Tanya Loos, environmental consultant and Vice President of BirdLife Ballarat. A total of 60 species have been observed so far. Birds have been seen using trees in the first biorich plantation site since October 2011. More information on the monitoring can be found on the *biorich plantation website* (Biorich 2012).

Overview

The analogue forest/biorich plantation concepts extend and expand the potential of our old tree planting mentalities and technologies. They help open up new ways of thinking about the kind of rural landscapes we want, and can create.

Adopting this approach requires an intergenerational commitment to the revegetation and management activities. While some kind of legal protection, such as a covenant, can protect forest/plantations on private land where ownership can change, the desire for landscape restoration needs to come out of local communities and have their long-term support.

The 'Imlal biorich plantation project' is still in its early stages, but the *Recreating the Country* book and film (on YouTube and accessible via the *biorich plantation website*) have generated a lot of interest in the concept, and BRT is now discussing with other organisations the potential for establishing new biorich plantations in the Ballarat area. BRT welcomes contact about its activities through the *biorich plantation website* email.

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Planting for people and the planet

BRT members and supporters at the ImLal biorich plantation sign near Lal Lal. Photo: Gib Wettenhall

Table 1: Blueprint for Sustainability Score Sheet. Source: Stephen Murphy

Design factors	**Score** **Maximum possible**	**Score** **For typical three row plantation**
DIVERSITY		
1. The number of species planted (one point for each species)	20*	5
2. The number of genera planted (two points for each genus)	20*	3
3. Food source potential and times available (up to 3 months nectar – 2 points; 3 - 6 months nectar – 4 points; 6 - 9 months nectar – 7 points; 9 -12 months nectar – 10 points)	10	4
STRUCTURE		
4. Plantation width (Over 25 m = 20 points; 20 – 24 m = 16 points; 15 –19 m = 12 points; 10 – 14 m = 8 points; 5 – 9 m = 4 points; less than 5 m = zero points)	20*	4
5. Number of structural layers (2 points for each layer)	10	6
6. Habitat potential and diversity (long lived hollow forming species – 4 points; short lived tall species – 2 points; short lived bushy species – 2 points; ground habitat potential – 2 points)	10	6
REPRODUCTIVE POTENTIAL		
7. Species grouping at planting (one point for average number of plants in each species grouping)	10	1
8. Genetic viability (2 points for each seed tree, in the seed collection. Averaged for each species)	20*	2
TOTAL OF FACTORS 1 - 8	**120**	**31**
LOCATION		
9. Connectedness to remnant vegetation (RVF) (*add* 25% of total score, if 0 – 50 m.; 20% if 50 – 100 m distant; 15% if 100 – 500 m; 10% if 500 – 1 km; 5% if 1 – 5 km distant)	25% of total of factors 1 - 8 *30 points max.*	1.5
10. Proximity of permanent water (PW) (*add* 25% of total score if water is insitue; 20% for permanent water with vegetation within 50 m; 15% for PW with veg. 50 – 100 m, or insitu PW with no veg.; 10% for PW with no veg. within 50 m; 5% for PW with no veg. 50 – 100 m distant)	25% of total of factors 1 – 8 *30 points max.*	1.5
TOTAL	**180 points**	**34 points**

Note: Shading indicates a minimum of 50% of the maximum possible score must be achieved for these factors. The ‘Sustainability Potential’ is downgraded one level for each Critical Factor scoring less than 50%. E.g. An initial score of ‘likely’ is downgraded to ‘marginal’, if one Critical Factor scores less than 50% or ‘unlikely’ for two poor scores.

Sustainability assessment

Sustainability index score	**Sustainability potential**
111 – 180 points	Highly likely
81 – 110 points	Likely
71 – 80 points	Marginal
61 – 70 points	Unlikely
Less than 60 points	Highly unlikely

Rehabilitation of the former construction sites of the Snowy Hydro-electric scheme in Kosciuszko National Park

Case Study: T2 Dogleg Spoil Dump

Elizabeth MacPhee

Office of Environment and Heritage. Email: Elizabeth.Macphee@environment.nsw.gov.au

Introduction

The Snowy Hydro-electric Scheme was constructed in the Snowy Mountains of southern NSW between the early 1950s to the mid 1970s. During construction multiple townships, camps, quarries, construction sites, spoil dumps and many other miscellaneous sites were built in the Snowy Mountains from the high alps to the montane zone. Decades after the scheme was completed, evidence of the lives of the people and the impact of the work they did still remains. Billions of tons of rock spoil, thousands of tonnes of steel, some contaminated materials and multiple exotic plant species persisted in the Kosciusko National Park (KNP) from the construction of the scheme. All of the former sites contravened at least one environmental Act and needed to be addressed.

In 2002 the Snowy Hydro-electric Authority was corporatised to Snowy Hydro Limited and 400 former sites were "handed back" to the NSW National Parks and Wildlife Service (NPWS) with a significant amount of money to repair them. All sites were assessed for the degree of environmental risk they posed in regard to geotechnical stability, soil, water, weeds, Aboriginal and European heritage, threatened species and contamination issues as well as its aesthetic and spatial position in the park. Due to the range and complexity of the sites and the issues they presented trial sites were established to test rehabilitation techniques. This article will focus on one of the trial sites, the rehabilitation of a 12 hectare rock crushing site called the T2 Dogleg spoil dump.

Development of rehabilitation techniques – A case study of the T2 Dogleg Construction site in KNP

The T2 Dogleg site is so named as it is in close vicinity to the T2 power station and is situated in very steep country on a switchback (or dogleg) on the Elliott Way in the northern part of KNP.. It was formerly a rock crushing site for the use in concrete making for the T2 Dam wall. It is an altitude of about 800 m in Peppermint and Manna Gum forest. It has an average slope of about 35 degrees.

The site presented a range of issues in regard to stability, access, weed control, pest animal control, lack of top or sub soils, protection of remaining native vegetation and how to reinstate native species for habitat reconnection and integration into the surrounding ecosystem. This site was also heavily burnt in 2003 which had exposed much of the waste and created instability.

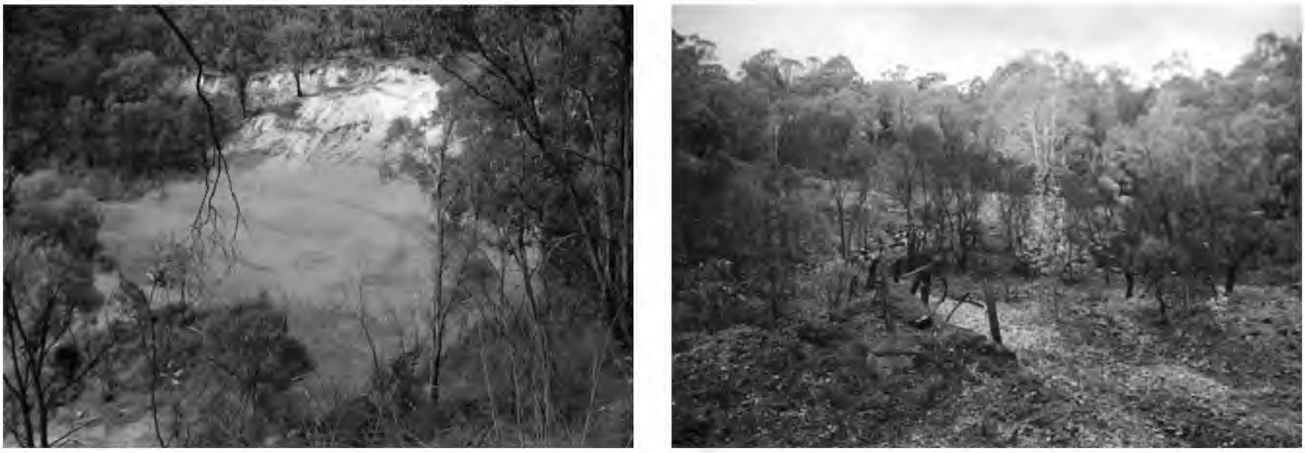
T2 Dogleg site – spatial position in the landscape post earthworks and pre planting. Photo: Rob Perry

Site treatments and discussion

The site was reshaped following standard bench/batter techniques. A lot of the steel waste and weeds (in particular large blackberry bushes) were buried in the process. The willows were cut down and poisoned and chipped and the remnant patch of vegetation was methodically gone through by volunteers and each blackberry cane was cut and painted. This resulted in a neat and accessible site, but with a mostly completely bare rock spoil surface with a north-westerly aspect

The site was used as a trial site and a variety of rehabilitation techniques were applied and monitored in regard to their success. The process divided the site into different rehabilitation techniques for monitoring (Table 1).

These trials were qualitatively assessed, with each of the nine batters of the slope having a different treatment to the other. Over 80,000 colonising tubestock were planted. The best survival and growth rates of planted seedlings was



The T2 Dogleg site in 2006 (pre planting) and in 2011 with full canopy closure. Photos: Rob Perry and Elizabeth Macphee

Table 1: Rehabilitation treatments and results for the T2 Dogleg site in KNP

Site treatment	**Result of treatment**
Small planting holes (twice the width of the tube and only slightly deeper than the seedling) with up to 5 L compost, 25 g of slow release fertilisers, pre-wet water crystals and straw mulch.	In steep rock spoil this method with gave the most consistent results in survival and establishment. Greater than 95% survival of seedlings.
Large planting holes (up to 2 m wide) that were terraced into the batter and 5 to 10 seedlings planted and using 50 to 100 L of compost.	Large planting holes were prone to the back face of the cut collapsing onto the seedlings and crushing them. The cuts in the batter were also a point of weakness in heavy rain and created erosion points. Less than 50% survival of seedlings.
Use of a cover crop (sterile Rye Corn) and jute matting to increase stability and to initiate biological activity in the rock spoil to increase planting establishment success.	The Rye Corn senesced after 10 months, and resulted in increased batter stability and organic activity on highly unstable pea gravel.
Use of log ladders (made from local wood and hard wood stakes) to create small terraces on the rock spoil and planting into the terrace. The terraces were created to improve access on the steep slopes and to 'break' the slope into small planting zones.	Provided an excellent way to access the pea gravel slope and created small planting niches – greater than 90 % survival of planted tubestock using the "small" planting hole technique.
Planting at 1 to 2 m spacing – using the "small" hole technique.	This resulted in the best outcome for ecosystem recovery by providing increased canopy cover, biomass and substrate for soil microflora and rapidly out competing weeds. In one year, the canopy was closed (i.e. branches of trees and shrubs were meeting) and competition with weeds was apparent.
Planting of seedlings on very steep slopes using fall arrest equipment (i.e. harnessing and ropes from a secure anchor). On very steep slopes small planting holes were cut into the slope with a short handled pick. A variety of hole sizes, angles and planting densities were evaluated.	Greater than 90% survival of seedlings using the small "hole" planting technique and the hole constructed at right angles to slope.
Direct seeding of a range of colonising native species (*Eucalyptus viminalis , E. dives, Acacia dealbata, A. melanoxylon, Cassinia aculeata* and *Dodonaea viscosa*) and covering the seed with straw, jute matting and a combination of both. Both autumn and spring sowing times were done to assess seasonal success.	Direct seeding on steep slopes of rock spoil was not successful: < 5% survival. Very few germinants survived from both sowing times, with only a small number establishing. Seed either washed into the cracks of the spoil or to the bench below, were removed by ants of birds, or did not survive on the rock spoil due to air spaces and limited biological activity in the spoil substrate.
The selection of plants was also assessed with a range of colonising native over-storey, middle storey and under-storey used in the planting. The species selected were post fire species that naturally rehabilitate the montane landscapes of south eastern Australia.	The use of native colonising species as tubestock was very effective in rehabilitating this site. Local species of the Myrtaceae, Proteaceae, Mimosaceae, Poaceae and Asteraceae families were particularly successful.

achieved with use of small planting hole with compost, slow release fertilisers and water crystals and has been adopted as the model for the majority of the former sites rehabilitation project. This site was completed in 2008 and currently has trees well over 12 metres in height and has essentially been integrated into the montane ecosystem of KNP.

Conclusion

To date the team have rehabilitated in excess of 150 sites in KNP with an altitudinal range between 600 m to 2000 m. Over 700,000 tubestock have been planted with an average of 90% survival and work is currently underway to create habitat for the Southern Corroborree Frog, Spotted Tree Frog and Mountain Pygmy Possum within some of the recently rehabilitated sites. In addition to the planting program, woody weed management in the higher reaches of Australia's largest catchment has been carried out with the intent of eradication or at least control of willows (*Salix* spp.), blackberries (*Rubus* sp.) and Scotch Broom (*Cytisus scoparius*).

The techniques developed in the rehabilitation of the Former Snowy Scheme Sites project potentially have application to multiple landscapes that are in need of ecological repair. The project was recently acknowledged for its contribution to land restoration by the Institute of Engineers Australia and was awarded the National Environmental Engineering Excellence prize in 2011.

Restoring patches: landscape restoration in practice

Justin Jonson

Threshold Environmental Pty Ltd, Albany, WA. Email: jjonson@thresholdenvironmental.com.au

Positive thresholds

Current discussions on ecological thresholds often focus on examples of biological systems at risk of collapse. Ongoing decline and degradation of natural systems is the trend. However as we seek to restore our environments through the process of 'landscape restoration' we are required to shift our minds away from the negatives of degradation, toward more progressive paradigms which focus on the return of self-sustaining ecosystems.

Fire triggered serotinous burn piles in flame within contour graded seams. Photo: Justin Jonson

While we cannot know for certain at what point such positive ecological thresholds will be crossed, we can have confidence that natural systems will respond with their characteristic self organisational properties when seeded appropriately. In practice, the restoration of landscapes is supported by the cumulative gains achieved through many on-ground projects. However the capacity of each individual site to contribute to the whole is dependent on the quality of works undertaken. In this way, there is a strong dependence on the initial conditions we set through our restoration treatments. Sites which re-establish plant populations that can directly contribute to ecological function at the patch scale, are central to achieving broader successes at the landscape scale.

Ecological restoration

Landscapes are diverse in abiotic conditions. As one moves spatially across a landscape there are many differences in soil types and landscape positions, and this is reflected in the plant communities within them. Tens of thousands of years of selective pressure have resulted in the mosaic of different vegetation associations and plant species distributions that we see today. This is nature's model, which demonstrates the physical conditions that best enable plant species presence and persistence. It is also a primary argument for why ecological restoration is the best approached to follow when replanting a given area of land (SER, 2004).

Function and resilience

When discussing goals for landscape restoration, terms like ecological function and ecological resilience are used to provide conceptual benchmarks for success. However little information is available to define what specifically this terminology means in practice. This becomes increasingly difficult as delivery organisations are faced with the challenge of applying conservation theory to their on-ground works (Fazey and McQuie, 2005). To bridge this gap between theory and practice, basic techniques of ecological restoration can be applied. The process begins with a goal of re-establishing the appropriate suite of plant communities, matched to their preferred soil type and landscape position, where species mixes are diverse and include a mix of different plant height strata. As this approach is continued over time, a greater familiarity develops with the individual characteristics of each species used. Through this process, a myriad of functions are revealed.

Genetically viable populations

Broadly speaking, ecological resilience across the greater landscape is expressed through the diversity of plant communities, the species within them, and their collective capacity to respond to disturbance, be it fire, disease, drought, flood, or clearing. Through restoration, we seek to support metapopulations through the re-establishment of well-placed genetically viable subpopulations. Operationally, this requires rigorous thinking and planning about how to utilize precious available seed resources. This includes considering when to include a certain species in a direct seeding mix applied at the broad-acre scale, when to grow small batches of seedlings, or hand broadcast small quantities of seed to re-establish or support subpopulations. Background information is also required to inform appropriate direct seeding rates for different species, so representative densities are achieved and highly viable species do not dominate the newly forming community. Across any landscape, one can find both common ubiquitous species and uncommon rare species. While common species are often easiest to establish, less common species often provide the unique signature of place, and associated functional diversity.

On ground treatments used in southwest WA

In the biodiversity hotspot of southwest WA, within the Fitz-Stirling operational area of Gondwana Link, efforts have been made to put theory into practice. The following are some of the approaches currently applied:

Go for heterogeneity

Landscapes are composed of different land units and associated ecosystems. The greater the diversity of such land units, the more diversity of ecological niches is expected. In restoration, we seek to cultivate the re-establishment of this natural heterogeneity. We attempt to do this through 'stacking' our treatments.

Broad acre direct seeding using a seven meter wide modified agricultural seeder. Each pass seeds five rows at 1.4m spacing. Photo: Lien Imbrechts

Stacking treatments

To support a high measure of ecological productivity, we aim to implement as many treatments as possible in our on ground restoration works. Using this terminology, a treatment can be considered as:

- Direct seeding of one of several seed mixes, specific to soil type, within a given land unit.
- Hand planting seedlings of ubiquitous species in a wide-spaced planting 'grid'.
- In situ 'cut and burn' approach, where serotinous plant material, species that release seed in response to a fire trigger (eg *Banksia* spp.), are lit on site.
- Transplanting sedges or grasses across the site to encourage new patches through stoloniferous or rhizomatous propagation.
- Planting seedlings of a targeted species in spatially discrete dense patches ('nodes') strategically distributed across site (Jonson, 2010).

Thinking across scales

Restoration at the patch scale contributes to a relatively small area. However, across the greater landscape, the cumulative contribution of these small localities of restoration can build on existing remnants to increase ecological structure, function, and resilience. Equally, yet at the finer spatial scale, each sub-system re-established within a restoration site makes a cumulative contribution to the site's overall ecological productivity. Where soils are shallow and hard, these values may be low, while areas of deeper friable soil types may turn out to be of higher productivity. Noting how this 'sum-of-the-parts make the whole' phenomenon occurs at multiple scales, the importance of each project is highlighted. It also highlights the genuine need for detailed restoration planning supported by hard data collected on-site to guide and inform on-ground works.

Conclusion

Ecological restoration is an information rich field of practice in which attention to detail and strong work ethic contribute significantly to project outcomes. There is no upper limit of effort when restoring at the paddock scale (greater than 100 ha). For each project, many opportunities exist to make incremental gains toward improving the ecological function of the local area. Ongoing review of ecological principals, and ongoing development of innovative approaches to apply them, is best practice restoration.

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Buffer zones for aquatic biodiversity conservation

Dr Gina Newton

Department of Sustainability, Environment, Water, Population and Communities. Email: gina.newton@environment.gov.au

Buffer zones are used worldwide as an approach to protect and manage sensitive ecological areas (Boyd 2001). The function and viability of terrestrial and aquatic communities can be improved through the application of buffer zones, by minimising external threats and encouraging land-use management in adjacent areas. The application of buffer zones offers a practical, cost-effective approach to significantly enhance conservation efforts for aquatic habitats and biodiversity.

Definitions and descriptions

A buffer zone is an area lying between two or more others that serves to reduce the possibility of damaging interactions between or through them (Ebregt and De Greve 2000). It generally refers to the area of land adjacent to a sensitive or 'protected' core area of natural habitat of either terrestrial vegetation or some form of water body (or both).

Wetland of Murray River in SA. Photo: South Australian Murray-Darling Basin NRM Board

A buffer zone also often constitutes or overlaps with an ecotone – a zone of transition between two different ecosystems such as the terrestrial habitat surrounding wetlands or adjacent to rivers (Winning 1997). Ecotones are often species diverse, providing critical habitat for fauna that are dependent on both ecosystem types. Research demonstrates that large areas of terrestrial habitat surrounding wetlands may be critical for maintaining biodiversity, and that both habitats must be managed as an integral unit to protect biodiversity (e.g. Boyd 2001; Semlitsch and Bodie 2003).

Benefits of buffers

A common method for reducing or eliminating impacts to aquatic resources from adjacent land uses and other pressures is to maintain buffers around the resources. For example, there is now sound evidence that providing riparian buffers of sufficient width protects and improves water quality by intercepting and trapping non-point source pollutants and sediments in surface and shallow subsurface water flow (Wenger 1999; Fischer *et al*. 2000). Table 1 provides an overview of the varied specific benefits of using buffers. Some higher level benefits include:

Maintaining ecological integrity - maintaining the structure, composition, function, and therefore the integrity and viability of aquatic systems, which are often subject to disturbances originating in adjacent or upland areas.

Minimising edge-effects - an edge-effect is an 'artificial' ecotone between the remnant natural ecosystem and the adjacent, often anthropogenically changed ecosystem

(Winning 1997), and is often characterised by disturbances such as weed infestation, dumped rubbish and partial clearing. Applying buffer zones to contain edge-effects can be important for sensitive areas of small size, such as small, disconnected wetlands, or narrow water courses.

Building resilience against climate change - climate change has critical implications for Australia's water resources and aquatic systems, including ecosystem function and services (Newton 2009). For natural systems and biodiversity, adapting to climate change impacts requires increasing resilience. Using buffers will contribute to building resilience of aquatic systems under management or conservation regimes.

Protecting groundwater - excavations into an aquifer have the potential to cause a local drawdown in the level of groundwater in the surrounding aquifer, potentially affecting the water hydroperiod (a critical variable in maintaining viable wetland communities) in any nearby wetlands that are groundwater dependent (Winning 1997). There is a strong relationship between groundwater drawdown and wetland hydroperiod. Lowered groundwater tables in areas surrounding wetland communities can decrease surface water depth and shorten periods of standing water within wetlands causing a shift in community structure toward species characteristic of drier conditions (Brown et al. 1990; Winning 1997). Buffers may assist with moderating the effects of groundwater extraction (McElfish et al. 2008).

Design and use of buffers

The success of buffers as a conservation/management tool depends on: setting clear objectives; careful design and management; evaluation of effectiveness to optimise the potential benefits for wetlands and their biota (Weston *et al*. 2009); and importantly, the width of the buffer (Keller *et al.* 1993 in Boyd 2001). Optimal buffer width for a particular wetland also depends on the conservation significance of the wetland and the purpose of the buffer (WRCWA 2000; WAPC 2005).

Castelle *et al*. (1992) suggest four criteria for determining adequate buffer sizes for aquatic systems:

- resource functional value (i.e. ecosystem function and ecosystem service perspective)
- intensity of adjacent land use
- buffer characteristics (e.g. slope, soil type, nature (natural versus artificial barrier, etc.)
- specific buffer functions required (e.g. sediment/nutrient removal, species diversity, etc.).

The recommended buffer zone widths for wetland/riparian ecosystems varies depending on specific objectives (see Table 2). To protect the environmental values of a wetland, as a general guide buffer widths of 30 - 50 m from the boundary of wetland dependent vegetation are recommended. However, buffer effectiveness generally increases with increasing width (Castelle *et al*. 1992). Several studies suggest larger widths, such as 200 to 500 m, are more effective for protecting fauna such as birds and reptiles, or reducing heavy metal pollution.

Mary River and riparian vegetation near Gympie in Queensland. Photo: Matt White

Buffers designed specifically to minimise groundwater drawdown or protect inflowing groundwater quality are also recommended at higher widths, such as around 200 to 2000 m.

Buffers and ecological communities under the EPBC Act

Within a buffer zone, management actions, including restrictions on resource use or development activities, may be used to enhance conservation value (Ebregt and De Greve 2000). Recently buffer zones have been applied to several terrestrial ecological communities listed as threatened under Australia's national environment law, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). For example, minimum buffer zones of 30 - 50 m were specified to enhance protection of small, fragmented patches of woodland, forest, and clay pan communities to help protect them from disturbance such as weed invasion and agricultural spray drift.

Any action or development likely to have a significant detrimental impact on a matter listed under the EPBC Act (such as a threatened ecological community or species) must be referred, assessed and approved (i.e. by the Minister for the Environment) before it can proceed. While not formally part of the ecological community, conservation outcomes can be enhanced by applying a buffer or 'zone of influence' to the listing description. Buffers also assist with guiding appropriate management around an ecological community. Actions within the buffer zone do not necessarily trigger the EPBC Act, but rather should be considered when determining possible significant detrimental impacts to a listed threatened ecological community. For the first time, large, complex riverine and wetland systems are under assessment as potentially threatened ecological communities under the EPBC Act. Using buffers for the listing and protection of these aquatic ecological communities is likely to be an effective approach to enhance protection of these sensitive systems.

Table 1: Benefits of wetland (riparian) buffer zones for a range of chemical, physical and ecological functions

Function	Benefit
Water Quality	• Protection of surface water runoff from surrounding land into the wetland (i.e. filtering/trapping of toxics) • Reducing sedimentation (soil erosion, trapping sediment) • Reducing eutrophication (excess nutrients, e.g. from fertilizers) – serving as nutrient sinks for surrounding watershed • Reducing pollution and spray drift (e.g. pesticides/herbicides, heavy metals) • Protection from rising salinity • Protection of inflowing groundwater quality
Microclimate	• Maintain microclimatic gradient • Provide shading and moderate water temperature • Provide wind break
Hydrology	• Reducing peak floods – water fluctuations • Moderate the impacts of altered hydrologic regimes and flooding • Stabilising stream channels and banks (e.g. enabling roots to hold soils) • Increase flood storage capacity of wetlands • Serving as key recharge points for renewing groundwater supplies • Protecting hydroperiod (which can influence ecology) • Reducing rate of infilling from sedimentation • Influences depth of water table • Enhances stream 'roughness' which affects flow regime • Groundwater interaction – prevention of groundwater drawdown
Wetland Fauna Habitat	• Maintenance of ecological processes • Providing feeding habitat - maintain productive food webs in-stream • Provision of a source of carbon to the wetland • Providing leaves and woody debris critical for aquatic organisms • Providing breeding/nesting habitat • Providing shelter/cover/overwintering sites • Protection of biodiversity • Minimisation of invasion by exotic species/weeds • Absorbing 'edge effects' on ecology • Protection from rising salinity
Wildlife Corridor	• Contribute to wildlife corridors between wetland and adjacent wetlands or bushland or other habitat fragments (i.e. for dispersal, migration, foraging etc.)
Fauna Protection	• Reduce disturbance from surrounding development (e.g. noise, light, movement from residential development; human activities) • Absorbing 'edge effects' on ecology • Provide a transition zone between upland and lowland habitats • Promote gene flow
Aesthetics/ Recreation	• Provide buffer between residential areas and nuisance insects e.g. midges, mosquitoes • Create a screen from incompatible scenery (e.g. industrial development) • Provide area for passive recreational activities (e.g. bird watching)
Management Tool	• Achieving desired values, processes, functions and other attributes/ ecosystem services of wetlands • Mitigate fragmentation and increase connectivity of isolated habitats • Protection against margin dieback • Biodiversity conservation and reserves of native species • Accommodate for 'fuzziness' of wetland boundaries (i.e. allow for expansion in times of flood)

Note: Adapted from Boyd 2001; Castelle et al. 1994; Davies and Lane, 1995; Fischer et al. 2000; Emmons and Oliver Resources 2001; Hairsine 1997; McElfish et al. 2008; DPIPWE 2003; DSE 2005; WAPC 2005; WRCWA 2000; Wenger 1999; Weston et al. 2009; Winning 1997).

Table 2: Recommended buffer zone widths for wetland/riparian ecosystems

Aspect	Objective	Recommended buffer width*	References
Temperature	Water temperature moderation/ shade	12 – 30 m	Castelle *et al.* 1994
		20 m[a]	Davies and Lane 1995
	Maintain microclimate gradient	45 m	Fischer *et al*. 2000
Nutrients	Reduce nutrient inputs (removal)	100 m[b]	Davies and Lane 1995
		200 m (sandy soils)	WRCWA 2000
	(reducing nitrate)	30 m	Wenger 1999
		30 – 48 m	Castelle *et al.* 1994
	(removal of phosphorus)	9 – 30 m	McElfish *et al*. 2008
	(removal of nitrogen)	30 – 48 m	McElfish *et al*. 2008
Pollution	Reduce pollution (heavy metal) input	100 m[b]	Davies and Lane 1995
		200 m (sandy soils)	WRCWA 2000
	Reduce pollution (pesticide removal)	> 15 m	Wenger 1999
Sediment	Reduce sedimentation (removal)	9 – 30 m	McElfish et al 2008
		30 m	Wenger 1999
		10 – 65 m	Castelle *et al.* 1994
		100 m[a]	Davies and Lane 1995; WRCWA 2000
Water quality	Improving/protection of water quality	5 – 30 m	Fischer et al 2000
		≥ 6 m[c]	DSE 2005
	Protection from land use	30 - 60 m	Semlitsch and Jensen 2001
Ecological processes	Maintain ecological processes/major food webs	10 – 30 m	Wenger 1999
	(carbon flow)	20 – 50 m[d]	Davies and Lane 1995; WRCWA 2000
	(large woody debris and organic litter)	30 – 50 m	Wegner 1999
Bank stability	Protect bank stability	20 – 30 m	DPIPWE 2003
Biodiversity	Protect biodiversity (species diversity)/ wildlife/ habitat	30 – 90 m	McElfish *et al*. 2008
		3 – 120 m	Castelle *et al.* 1994
		> 100 m	Wenger 1999
		100 – 170 m	Brown *et al.* 1990; Keller *et al*. 1993
	Bird habitat	40 – 500 m	Fischer *et al.* 2000
	Reptile/amphibian habitat	30 – 1000 m[e]	Fischer *et al.* 2000; Semlitsch and Bodie 2003
	Mammal habitat	> 50 m	Fischer *et al.* 2000
	Maintain benthic invertebrates in streams adjacent to logging	32 m	Erman *et al.* 1977 and Newbold 1980 in Castelle *et al.* 1992
Insects	Nuisance insects	100 – 800 m[f]	Davies and Lane 1995; WRCWA 2000
Groundwater	Protection of inflowing groundwater quality	2000 m[g]	Davies and Lane 1995; WRCWA 2000; DSE 2005
	Minimise groundwater drawdown	[h]35 – 170 m	Brown *et al*. 1990
Salinity	Protection from rising salinity	250 m	Davies and Lane 1995; DSE 2005

Notes: * generally measured from edge of wetland or each side of stream, except where noted otherwise; a = Measured from seasonally inundated zone; b = Measured from wetland dependent vegetation; c = Low overland flow rates; d = Measured from outer edge of open water; e = 130 - 290 m for critical core habitat; f = Measured from permanent water; g = For sandy soils/in direction of groundwater flow; h = Small wetlands, soil type & slope influence

Conclusion

Weston *et al*. (2009) suggest that the proposed role of a buffer zone in the conservation of biodiversity should be stated explicitly as one or a combination of: a) provision of habitat, b) provision of corridors and/or c) reduction of disturbance – as each goal potentially engenders different buffer designs, management, and balance between recreational and wildlife needs. The creation of ecologically meaningful guidelines for the establishment of buffers is imperative if they are to fulfil the role of enhancing nature conservation. Such guidelines should be informed by appropriate science, much of which is not yet available, especially in the Australian context (Weston *et al*. 2009). The increasing use of buffers in the description of threatened ecological communities, particularly aquatic systems, and their associated recovery plans represents a valuable approach to enhancing aquatic biodiversity conservation at a national scale and should help inform the development of such guidelines.

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Pollination biology of Western Australia's Showy Everlasting Daisy (*Schoenia filifolia* subsp. *subulifolia*)

Guochen K. Png

Department of Environment & Agriculture, Curtin University, WA. Email: g.png@student.curtin.edu.au

Introduction

The Showy Everlasting Daisy (*Schoenia filifolia* subsp. *subulifolia)* is endemic to Australia's Mid-West. It is also a popular garden annual that produces showy, enduring yellow blooms in great abundance throughout spring. However, this native daisy is Declared Rare Flora under the Western Australia *Wildlife Conservation Act 1950* and Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*. Threats to this subspecies mainly arise from the negative effects of agricultural activities surrounding the known subpopulations.

The species is commonly propagated by bush-collected seeds (Choengsaat *et al.* 1998). Although the methods of enhancing seed germination and effects of moisture on seed production have been studied (Choengsaat *et al.* 1998), little is known about its pollination biology. Improved understanding of its pollination biology can assist conservation efforts and maximise seed production in seed-based nurseries.

Majority of the Asteraceae family are known to be out-crossing and insect-pollinated (Stebbins 1970). However, two tribes of Asteraceae, Ambrosiinae and Anthemidae, are known to have adopted wind-pollination (Stebbins 1970). The flowers of the Showy Everlasting are hermaphroditic (both male and female reproductive structures present within each flower), bright, showy and yellow, and thus have the characteristics of an insect-pollinated plant. This study aims to determine the crossing-type of the Showy Everlasting and if it can also be wind-pollinated through field and pollen studies. Elucidation of the pollination strategy utilised by the species is important for establishing the best strategy to optimise seed yield for rehabilitation planting or *ex situ* conservation.

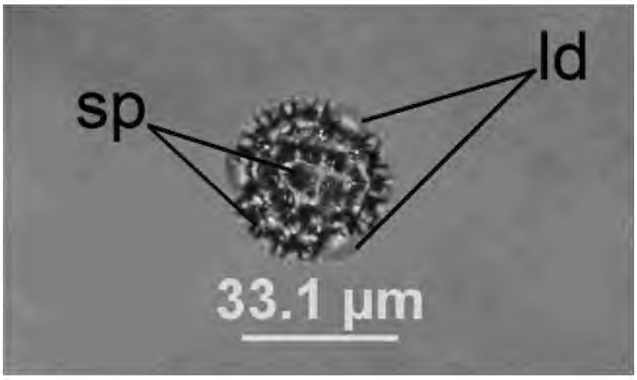

Image of a typical Showy Everlasting Daisy's pollen grain. Key: sp, spikes; ld, liquid droplets. Photo: Guochen K. Png

Plant Materials

Showy Everlasting plants used were raised from commercially purchased seeds, in round pots, using a 1 peat moss: 1 sand: 1 soil (by volume) potting mix, supplemented with *Osmocote®*.

Crossing-type

Seed set/density was compared between the treatments of: a) control – no treatment, b) hand-selfed – transfer of pollen between 10 flowers on the same plant and c) reciprocal hand cross-pollinated – transfer of pollen between 10 pairs of flowers between two plants. Each treatment was replicated three times. Using insect-proof cages within a glasshouse, individual plants with unopened flower buds were isolated for control and hand-selfed treatment; and in pairs for reciprocal hand cross-pollination. Two weeks after blooming, a soft paint brush was used to transfer pollen between flowers. After two months, seed set/density of each treatment was calculated. Interactions between pollen and stigma (female reproductive part of a flower which receives the pollen during pollination) of the various treatments were observed using a UV-microscope, aided by aniline blue stain.

Pollen Studies

Pollen morphology was examined microscopically and compared with similar studies reported in the literature to predict the favoured pollen dispersal strategy. The effect of wind on pollen dispersal was also assessed by setting up pollen traps around a compact plot of 50 flowering plants - three at each distance of 0.3, 0.5 and 1.0 metres away - for five rainless days, to compare pollen densities.

Results

Only reciprocally hand cross-pollinated flowers, that is, crosses between flowers of different plants produced seeds (40 ± 17 seeds produced per cm^2 of flower-head area). UV-microscopy revealed that most control and hand-selfed flowers sampled contained stigmas with pollen grains that displayed inhibited pollen tube growth (Figure 1a). If uninhibited, the pollen tube would grow from a compatible pollen grain (on the stigma) to form a conduit that transports the male gametes (sperm cells) to the ovules during fertilisation. Most reciprocally hand cross-pollinated flowers sampled contained pollen producing continuous pollen tubes, which can be traced from the stigma to the respective ovary.

The pollen grains were spiny and relatively round, with a mean diameter of 32.9 ± 0.1 µm. Liquid droplets were observed on the surface of pollen grains. Pollen density decreased as the distance from the flowering plot increased.

Discussion

The Showy Everlasting Daisy is self-incompatible (xenogamous), as only flowers that were hand cross-pollinated with flowers of another plant yielded seeds. Xenogamy was further supported by the pollen-stigma response in self-pollinated florets – inhibited pollen tube growth on the stigmas of self-pollinated flowers. Self-incompatibility in this subspecies concurs with studies done on many closely-related Asteraceae species. This breeding mechanism may be an evolutionary advantage that serves to avoid inbreeding depression. On the downside it means that a new population cannot establish from a single plant or genetically identical plants, which is a consideration for conservation projects.

Pollen morphology of this subspecies is very similar to the pollen of many insect-pollinated species found in the various Asteraceae tribes e.g. Heliantheae, Inuleae and Eupatoireae. The spines of the pollen grains assist insect dispersal, by enabling the pollen to adhere to the insect pollinator's body parts for dispersal (Fægri and van der Pijl 1979). Liquid droplets on the surface of the pollen were possibly lipid-based globules that were found in other insect-pollinated species, which aid adhesion to other pollen grains (for dispersal in packets) and/or to an insect/animal pollinator (Fægri and van der Pijl 1979). The pollen could also be wind-dispersed, as it was found to be within the range of pollen sizes of wind-pollinated (17-58 µm) and animal-pollinated species (5-200 µm) (Wodehouse 1935). However, pollen-trapping results suggest that wind dispersal may be limited at distances of more than a metre, possibly due to height limitations of the plant (~ 0.5 m).

The Showy Everlasting Daisy is an obligate out-crosser that can only breed with another plant, and is potentially able to utilise both wind (over short distances) and insect pollen dispersal strategies. Therefore, it is recommended that the seeds/seedlings are planted in dense flower plots in the presence of wind and/or insects to maximise seed set.

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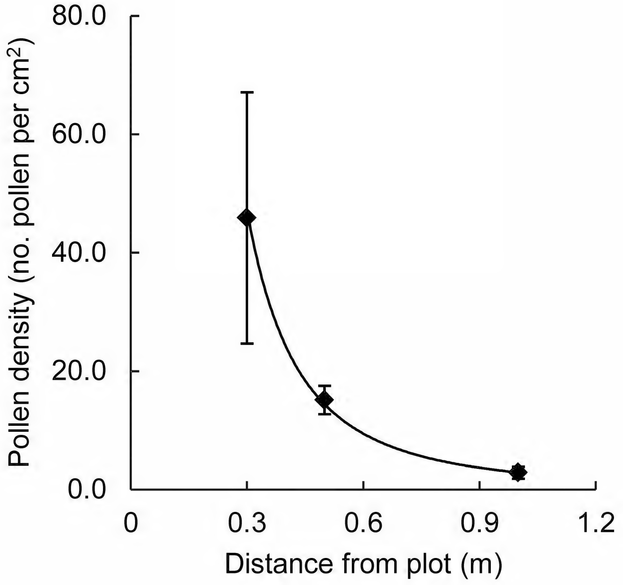
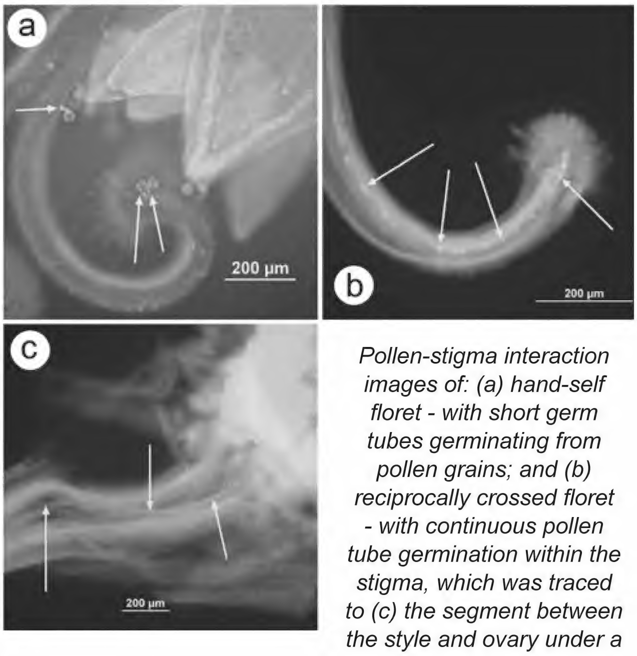


Showy Everlasting Daisy's pollen densities at distances of 0.3, 0.5 and 1.0 m away from flower plot. Bars represent standard errors. Photo: Guochen K. Png



Pollen-stigma interaction images of: (a) hand-self floret - with short germ tubes germinating from pollen grains; and (b) reciprocally crossed floret - with continuous pollen tube germination within the stigma, which was traced to (c) the segment between the style and ovary under a UV-microscope. Photo: Guochen K. Png

Azorella macquariensis – Battling for survival in the furious fifties

Lorraine Perrins

Royal Tasmanian Botanical Gardens, Hobart, Tas. Email: L.perrins@rtbg.tas.gov.au

Macquarie Island

Lying in the ‘Furious Fifties’ approximately 1545km Southeast of Tasmania, Macquarie Island is an Australian Subantarctic Territory managed by the Tasmanian Government Parks and Wildlife Service. The origin of the island is unique; being a very rare example of recently uplifted oceanic crust formed around 11 million years ago, and is the only place where the earth’s mantle is being exposed above sea level. Each year thousands of oceanic birds and mammals congregate on Macquarie Island to breed in phenomenal numbers.

Sir Douglas Mawson, the Australian polar explorer, being well aware of the importance of Macquarie Island, championed a large public movement successfully petitioning the Tasmanian government to close a penguin oil processing facility on the island in 1920. This action is widely considered to have been the world’s first wildlife conservation movement. The entire Island has been managed as a nature reserve since 1970 and was inscribed on the World Heritage List in 1997 on the basis of its “outstanding natural universal values”.

Cushion dieback

Protecting an area does not guarantee the safety of all its inhabitants, and in December 2008 dying back of the Macquarie Island Cushion plant, *Azorella macquariensis,* was noticed by Australian Antarctic Division (AAD) staff. *Azorella macquariensis* is one of only four plants endemic to Macquarie Island and is considered the keystone species of the feldmark, a plant community on the sparse plateau uplands, covering 45% of the Island.

Since the dieback was first noted *A. macquariensis* has undergone a catastrophic decline. It is now evident across the plant’s entire range and it is anticipated that it could become extinct in the wild within a few years. Unfortunately the demise of the *Azorella* may mean that the entire feldmark community is at risk of collapse.

The Macquarie Island Pest Eradication Program has made good progress towards the elimination of rabbits on the island and there are initial signs of the flora recovering. Rabbits, however, have not been the cause of the *A.macquariensis* dieback. The harsh plateau uplands have too hostile a climate and provide minimal browsing opportunities for rabbits. Although there is still much research to be done it appears that the cause may be multifactoral and will not be resolved in the short term.

Royal Tasmanian Botanical Gardens staff member Michelle Lang on Macquarie Island in 2010. Photo: Michelle Lang

Research to date has involved scientists from Universities in South Africa and Canberra, as well as the Australian Antarctic Division, the Biodiversity Conservation Branch of the Tasmanian Government, and staff from the Tasmanian Parks and Wildlife Service (PWS) and the Royal Tasmanian Botanical Gardens (RTBG).

Ex-situ collections

To prevent the total extinction of this plant it is vital that an *ex-situ* collection is maintained. This can be done by collecting and storing seed, however there has been limited success in obtaining adequate quantity of seed because of the difficulties of collecting in Macquarie Island’s climate. Some germination studies are being currently performed at the RTBG with a small amount of material from a 2010 seed collection and initial results suggest that this species exhibits physiological dormancy.

Maintaining individual plants as an *ex-situ* collection at the RTBG has not been possible due to difficulties with the strict quarantine and the harsh environmental conditions required to grow this species. In March 2010 a RTBG staff member travelled down to Macquarie Island to set up a trial, potted conservation collection situated away from infected areas and artificially irrigated.

The plants are monitored via monthly photographs sent from rangers on the Island. They are still growing well making this a successful way of maintaining a protected collection of this species.

Long-term challenges

Although all the environmental conditions can be met with an on-island, living collection, it still remains a costly exercise. The logistics of transporting equipment and resources down to Macquarie Island are extremely expensive. However it appears to be our best option in buying time to understand fully the factors causing the *Azorella* dieback and insuring that this species is conserved for the future.

Plans are now in place to expand the *ex-situ* collection to 54 individual plants collected from across the Island. This collection will also serve as a seed orchard, where individual plants may be cross-pollinated to hopefully enhance seed-set and broaden the genetic make-up of the seed collected.

The RTBG has been awarded a partial grant from the prestigious Mohamed bin Zayed Species Conservation Fund to assist with the development of the ex-situ collection. The Mohamed bin Zayed Species Conservation Fund is a significant philanthropic endowment established to provide grants to individual species conservation initiatives, recognise leaders in the field of species conservation, and elevate the importance of species in the broader conservation debate. It is funded entirely by His Highness General Sheikh Mohamed bin Zayed Al Nahyan, Crown Prince of Abu Dhabi, and is one of the few international conservation grants available to single species conservation. The RTBG would like to acknowledge the Fund for their generous support. More information about the Mohamed bin Zayed Species Conservation Fund can be found at - http://www.mbzspeciesconservation.org/

Can you help?

The RTBG still requires $10,000 for this program and is currently running an appeal to raise the remaining funds. Brochures can be accessed electronically via the RTBG website – www.rtbg.tas.gov.au/conservation , (follow the link to the *Azorella macquariensis* page). Any donations would be gratefully received and are tax deductible.

If you would like to find out more about this program please contact Lorraine Perrins, Curator Subantarctic Island Flora and Conservation Collections on (03) 6236 3082, or Natalie Tapson, RTBG Horticultural Botanist (03) 62363052.

Azorella macquariensis *trial potted collection on Macquarie Island, December 2011. Photo: A.Pyrke*

Report from New Zealand Plant Conservation Network

Kerry Gillbanks

Auckland Council, NZ. Email: kerry.gillbanks@aucklandcouncil.govt.nz

Book of the Year

The New Zealand Post Book Awards are an annual award identifying the best books written by New Zealanders. John Dawson and Rob Lucas's book, *New Zealand's Native Trees*, won in its category of the Best Illustrated Non-Fiction award and also took out the overall supreme award Book of the Year. The book took more than seven years to complete with thousands of kilometres spent driving throughout the country and countless hours spent walking through some of the country's most inaccessible areas. It describes and illustrates more than 320 species, subspecies and varieties and with more than 2300 photos to show detail of flowers, fruit and other features. A beautiful and valuable reference book!

The National Pest Plant Accord

The National Pest Plant Accord (NPPA) was created in 2001 to help prevent the spread of invasive plant species through the nursery trade or casual trading. Under the agreement between government departments, regional councils and the nursery industry, these plants are illegal to propagate, distribute or sell. In 2011 the second review of the list was started and due to the number of submissions received the review was extended and its completion date was in early 2012. Thirteen new pest plants have been added to the list. All of the plants on the NPPA registrar are unwanted organisms under the *Biosecurity Act 1993*.

The full list can be viewed on http://www.biosecurity.govt.nz/nppa

Network/Website Updates

The Network's new website strategy has led to a new design for our website which will improve your interaction with plant information. This will be launched shortly. Keep an eye out for it.

As mentioned in our last report our upcoming conference will be held in 2013 to coincide with our 10th year anniversary. Planning is now underway and it will be held in Auckland in May 2013.

Visit www.nzpcn.org.nz for more information.

Conferences and Workshops

2012 ANPC Conference

29 October – 2 November 2012
Canberra, ACT

The ANPC marks its 21st year in 2012. To celebrate the occasion, the 9th ANPC National Conference will:

- review and highlight plant conservation achievements in Australia over the last two decades
- evaluate the strengths and weaknesses of our existing approaches to plant conservation
- highlight current major issues facing plant conservation in Australia
- identify plant conservation directions in Australia for the coming decades.

The overall conference theme is plant conservation in Australia, achievement and future directions. Sub-themes include:

- Threats
- Conservation policy
- Plant conservation strategies
- Vegetation, soil and water context
- Ecological restoration
- Role of the NGO sector.

The conference will include invited key note papers, contributed papers, posters and workshops, as well as field trips in the ACT region to examine on-ground plant conservation activities. Further information available at http://www.anbg.gov.au/anpc/conferences/2012/themes.html.

Seed collection, storage and use for native vegetation restoration ANPC workshops

5 November 2012; The Australian Botanic Garden, Mount Annan NSW
3 April 2013; University of the Sunshine Coast, QLD

This workshop will provide participants with the knowledge needed to effectively collect, store and use seed in native vegetation restoration.

Topics covered include:

- developing a collection strategy
- seed collection methods
- pest and disease management
- seed banking
- seed germination & dormancy
- experts in the use of native seed will present a selection of case studies.

For more information, including a full program, flyer and registration form please visit http://anbg.gov.au/anpc/courses.html

Translocation of threatened plants ANPC workshops

6-7 November 2012; The Australian Botanic Garden, Mount Annan NSW
4-5 April 2013; University of the Sunshine Coast, QLD

This two day workshop will provide participants with the knowledge required to effectively plan, implement and evaluate translocation projects for threatened flora.

Questions addressed include:

- When is it appropriate to use translocation as a tool to conserve threatened species?
- What needs to be done when planning a translocation program?
- How should a translocation program be implemented?
- What ongoing management and evaluation is required?

The workshop will include case studies of translocation programs, highlighting lessons to be learnt and an optional full-day field trip to translocation recipient sites for a range of threatened plants.

For more information, including a full program, flyer and registration form please visit the http://anbg.gov.au/anpc/courses.html

Conferences and Workshops (cont.)

Strategic planning approaches to improve biodiversity conservation

14-15 November 2012
Sydney, NSW

Balancing biodiversity conservation outcomes with social and economic priorities is a complex and challenging task. Strategic Planning Approaches to Improve Biodiversity Conservation will bring together the key players currently developing strategic and landscape scale approaches to protect biodiversity and streamline development assessments to support urban and regional growth.

Discussions will include:

- EPBC Act and COAG environment regulatory reform
- How to implement landscape scale approaches to protect biodiversity
- Strategies for streamlining planning approvals to cut green tape
- How to provide long-term certainty for conservation & development.

For more information and to register visit www.biodiversityoutcomes.com.

Jewels in the landscape: managing significant native vegetation remnants ANPC workshop

20-21 November 2012
Moree NSW

This two day workshop will provide participants with the skills required to plan, implement and monitor a project to manage and restore grassy woodland remnants.

Learning will be through a combination of theory presentations and field-based activities.

The workshop has a particular emphasis on managing grassy woodland remnants but is relevant to the management of other vegetation types.

Topics covered include:

- ecology of grassy woodlands
- weeds and weed management in grassy woodlands
- grassy woodland restoration
- grazing for biodiversity
- planning a management and restoration project
- flora identification skills
- identifying the natural values of a site and its threats
- identifying vegetation community type
- vegetation monitoring techniques
- where to get help including an overview of funding opportunities.

For more information, including a full program, flyer and registration form please visit https://www.anbg.gov.au/anpc/courses/TSR_Workshops/Moree.html

Society for Ecological Restoration Australasia Conference

28-30 November 2012
Perth, WA

The Society for Ecological Restoration Australasia's Inaugural Conference will feature restoration topics of global interest, including themes on 'Our restoration capabilities within a changing world'. For more information visit http://www.seraustralasia.com/pages/conference.html

Ecological Society of Australia Annual Conference Ecology: Fundamental Science of the Biosphere

3-7 December 2012
Melbourne, Vic

The theme for Ecological Society of Australia's 2012 annual conference is Ecology: Fundamental Science of the Biosphere. The aim is to "get back to basics" and focus on the scientific inquiry that underpins our discipline. Ecology is fundamentally important to the conservation and wise management of the Earth's natural resources. The outcomes of our work matter! It needs to be based on rigorous theory, survey, experimentation and modeling. For more information visit the conference website http://esa2012.org.au/index.asp?IntCatId=14

ICBB 2012: International Conference on Biotechnology and Biodiversity

6-7 December, 2012
Perth, WA

The 8th International Conference on Biotechnology and Biodiversity aims to bring together leading academic scientists, researchers and scholars to exchange and share their experiences and research results about all aspects of Biotechnology and Biodiversity, and discuss the practical challenges encountered and the solutions adopted. For more information visit the conference website http://www.waset.org/conferences/2012/perth/icbb/

Student Conference on Conservation Science

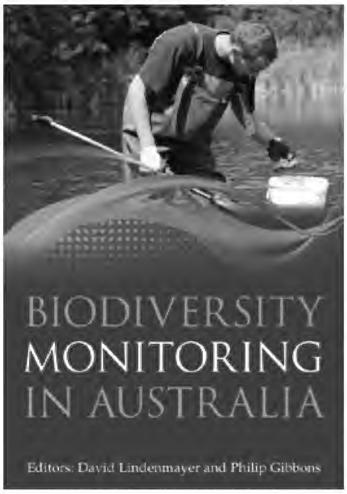
21-31 January, 2013
Brisbane, QLD

The Student Conference on Conservation Science Australia will bring together 100 post-graduate students from the Asia-Pacific region and elsewhere to develop their skills and forge lasting professional relationships in this, the most biologically and culturally diverse region in the world. People who are not currently enrolled in a research degree but are working at a similar level in a conservation organisation are also welcome to attend. More information can be found at the web site: www.sccs-aus.org

Book reviews

Biodiversity Monitoring in Australia

Edited by David Lindenmayer and Philip Gibbons
CSIRO Publishing, April 2012
224 pages, Paperback, ISBN: 9780643103573
Price: AU $49.95
Available from: www.publish.csiro.au.
An eBook version is available from eBooks.com



In the late 1940s a monitoring program centred on Fisher Island Field Station in Bass Strait was established to learn about the life history and migration of the shearwater. The monitoring has continued to the present and the program has not only provided information underpinning conservation management for the birds, in more recent times the work has thrown light on initially unanticipated wider questions about oceanographic and climatic changes. This would be one of the longest running monitoring projects on a single species in the nation. On the back of the shearwater monitoring studies have been many collateral studies by other scientists on the biota around the field station. Examining the results of long-term monitoring studies such as those at Fisher Island as well as examples given in this book should leave little doubt about the importance of monitoring.

In this volume there are contributions about large scale monitoring and national trend reporting as well as smaller scale monitoring that informs adaptive management and answers specific questions. The latter is necessary to provide better understanding of ecological and biophysical processes and provides important insights into causal relationships between on-ground actions and resulting changes in ecological processes. This also contributes explanatory power to the interpretation of broad scale monitoring data.

The need for a well-funded and designed, long-term national monitoring program is urged by various contributors to this volume invoking remarks in the 2006 Australian State of the Environment (SOE) report (the nation "needing an enduring environmental reporting system"). Since the 2006 SOE report there was a concerted effort by the National Land and Water Resources Audit (NLWRA) to find long term monitoring data or spatial information that could form the basis of national reporting. Some successes resulted in a much improved basis for the 2011 SOE report. Although the NLWRA was terminated, the need for better national biodiversity monitoring was recognized in the brief given to Bureau of Meteorology under the National Environmental Information System (NEIS). National legislation is apparently being prepared to provide a head of power for collection and maintenance of national environmental and biodiversity datasets. I suggest this could be eventually broadened to encompass more state-held data. The potential value of this is demonstrated in the National Vegetation Information System built by contributions from all governments and which provides a basis for interpreting biodiversity monitoring data. A large effort being made by the Terrestrial Ecosystem Research Network (TERN) is contributing to consolidation of national data on species and plot information as well as monitoring data. Recent attempts by TERN to build a bridge to the NEIS and forge some policy connections with national monitoring needs are to be welcomed.

This book is a valuable contribution to conservation biology practice in Australia and admirably broadens the discussion about monitoring at a critical time. I can hardly think of circumstances where conservation practitioners working in the field will not be involved in monitoring at some stages of their work and this book will be a very useful addition to the bookshelf of park rangers, NRM and government practitioners. It is very readable and brings together a broad collection of perspectives on monitoring informed by wide-ranging experiences across the country. It is well set out and arranged to quickly convey key messages.

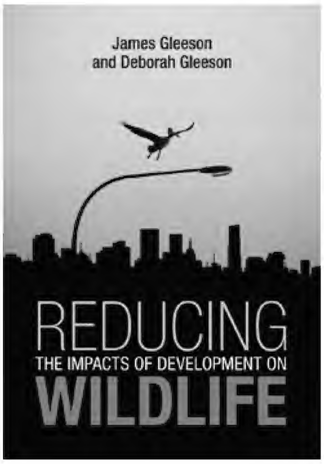
A thoughtful and constructive summary is given by Lindenmayer and Gibbons at the end of the book where issues that were raised consistently are detailed. The book will provide guidance for Australia's Biodiversity Conservation Strategy 2010-2030 as well as State government initiatives.

Dr Stephen Harris, Department of Primary Industries, Parks, Water and Environment, Hobart, Tasmania.

Book reviews (cont.)

Reducing the impacts of development on wildlife

by James Gleeson and Deborah Gleeson
CSIRO Publishing, April 2012
248 pages with colour photographs and illustrations
Paperback, ISBN: 9780643100329
Price: AU $89.95
Available from: www.publish.csiro.au



Australia's biodiversity is under continued threat from development, including agricultural, residential, industrial infrastructure and mining developments. With an increase in the number of threatened species and communities in Australia, effective measures to minimise the impacts of such developments are becoming more important. Furthermore, developers are now required by legislation to minimise their impacts on wildlife.

Now there is a book to assist in assessing potential measures and develop an effective strategy to minimise the impacts. *Reducing the Impacts of Development on Wildlife* provides a comprehensive range of practical measures to minimise impacts of development on wildlife, in an Australian context. This includes a range of measures not often discussed in detail. The book discusses a variety of strategies to reduce impacts such as during land clearance, by modifying human behaviour (eg through education and signage), to deter fauna from potential hazards at a development site, to allow the movement of fauna around and through a development site and to minimise habitat degradation. Additionally, the book includes measures to provide supplementary habitat in the form of constructed or artificial habitats (e.g. dams and nest boxes) as well as offsets.

The book begins by providing a brief introduction of the scope and structure, followed by an outline of the ways in which developments potentially impact on flora and fauna and the importance of understanding the ecology when selecting measures to reduce impacts. The following chapters discuss measures to minimise impacts in detail. This follows the hierarchy of environmental impact assessment, namely, first measures to avoid, then to minimise and finally to offset are presented. Each measure discussed includes a thorough description, outline of its application and discussion of its effectiveness. Importantly, the potential impacts of the biodiversity conservation measure on other facets of the environment are also discussed allowing the benefit of the measure to be weighed against potential impact to other environmental aspects. In addition to the detailed discussion, each measure is summarised in a table to allow easy assessment and comparison of pros, cons, costs as well as companion and alternative measures to consider.

Although much of the book is focused on minimising impacts to fauna, there are a number of detailed sections on managing impacts to flora, including plant salvage during land clearance, weed prevention and control, revegetation and restoration of ecosystems and *ex situ* measures for conservation such as seed preservation and translocation. The book also covers general measures useful for both flora and fauna protection including conservation planning, buffers, environmental offsets, monitoring and adaptive management.

This book is clearly written and presented. It is structured so that it can be easily used as a reference book, or read from cover to cover. It is well supported with examples, case studies, colour photographs and diagrams. Importantly, Australian examples and case studies are used, the measures are assessed for their use in the Australian context and for their effectiveness in relation to Australian wildlife.

Don't judge a book by its cover! Although the cover is eye catching, at first glance this book appears to be about "Reducing Wildlife" with these two words of the title in much larger font than the others. Perhaps this is a ploy to attract ruthless developers, so they too can learn some cost effective measures to protect our wildlife?

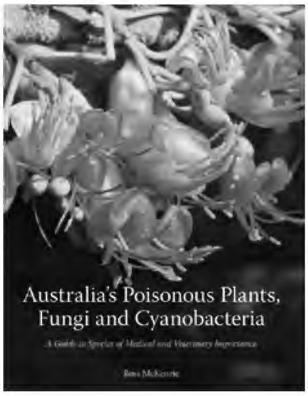
This book would be an invaluable reference book for daily use by environmental managers, consultants, developers, policy makers and regulators to help in choosing suitable, cost effective measures to minimise impacts of a development on wildlife. A much needed resource!

Selga Harrington, Parsons Brinckerhoff, Canberra ACT.

Book reviews (cont.)

Australia's Poisonous Plants, Fungi and Cyanobacteria A guide to species of medical and veterinary importance

by Ross McKenzie
CSIRO Publishing, June 2012
976 pages with colour photographs
Hardback, ISBN: 9780643092679
Price: AU $195
Available from: www.publish.csiro.au


Australia's Poisonous Plants, Fungi and Cyanobacteria
A Guide to Species of Medical and Veterinary Importance
Ross McKenzie

Australia's Poisonous Plants, Fungi and Cyanobacteria - A Guide to Species of Medical and Veterinary Importance is a beautiful, rich labour of love. Adopting the adage that *knowledge is power*, Ross McKenzie aims to save lives and prevent people and animals from suffering needlessly. Ross has distilled a life's work as a veterinary pathologist, toxicologist, research scientist and lecturer into this book. He demonstrates his pedagogical skills within a well ordered yet comprehensive text. *Australia's Poisonous Plant, Fungi and Cyanobacteria s* is the work of a scientist, but will also help non-specialists unravel the complexities of botany and toxicology. The book is enlivened with sparkling quotes, sayings and poems; though I'm not sure if the photo of a belly next to the bellyache bush was intended this way!

The book includes vascular plants, algae and fungi. In accordance with McKenzie's objective, the book includes native and exotic species; including weeds and species in cultivation. The line is drawn at what can be seen by the naked eye. The book claims to include all species known and suspected to be poisonous to humans and animals (livestock, pets, performance animals and native species) at the time of publication.

The introductory chapters of *Australia's Poisonous Plants, Fungi and Cyanobacteria* will help users understand the complexities of the subject matter and the content of the book. Chapter 3 focuses on types of poisoning, then chapters 4 to 14 are devoted to poisonous species. These chapters provide photographs and a high level of detail on species considered particularly toxic, widely distributed or relatively abundant. Species not included in these chapters are listed within chapter 15, the 'Digest'.

Chapters 4 and 5 are devoted entirely to cyanobacteria and fungi (respectively) then chapters 6-14 cover vascular plants, organised by growth form. While this is probably a sensible approach, it can occasionally be confusing to know which chapter to search for some borderline species. For example *Lantana montevidensis* is listed as a vine but can look like a shrub. Cross referencing could have been helpful in this case (e.g. species listed in alternative form with a cross reference to the detailed discussion).

Within each growth habit chapter plants are listed alphabetically by family and then by flower characteristics (if there are numerous entries). This places similar looking plants together which seems helpful, although there is some reliance on knowing what family plants belong to if you want to navigate around the book without constant reference to the index. To help non-botanist users however, McKenzie provides a very good introduction to plant ID, including a nice photographic botanical 'glossary'. This approach seems to be consistent with the emphasis McKenzie places on the need for accurate identification of plants. While making it clear that the book is not designed for accurate botanical identification he helps non-botanists by explaining clearly how to get help with ID from the state herbariums and how to handle samples for identification.

Needless-to-say the book can be complex for non-specialist users. Sometimes it can be hard to find 'the wood for the trees'; for example: Kikuyu doesn't rate a mention in the index. It is only listed in the Digest under its old botanical name *Pennisetum clandestinum* (now known as *Cenchrus clandestinus*), which may not be well-known.

Moving backwards; once your suspect plant has been identified, the listing refers you to chapter 3, which provides a detailed poisoning profile for different types of plant toxins. This is a good, concise approach that is consistent with diagnostic practice (observation of the signs and symptoms of poisoning). The text in this section is organised according to the organs and body systems affected by plant toxins. McKenzie highlights potential traps such as variability in toxic effects and the signs and symptoms of poisoning. McKenzie points out that sometimes apparent poisoning may in fact be an allergic reaction, and he explains that the book focuses on poisoning, that is, where plant chemicals damage tissues in proportion to their dose.

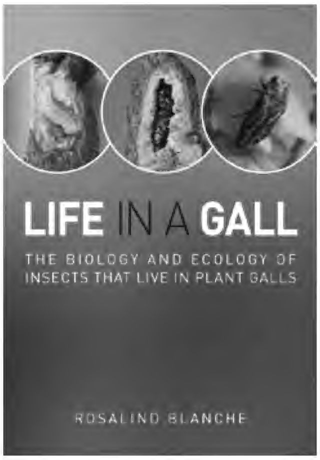
With Australians becoming increasingly curious about our native plants, bush tucker and plant-based medicine, this book is timely. *Australia's Poisonous Plants, Fungi and Cyanobacteria* goes a long way towards exposing a complex subject to both non-botanists and non-toxicologists. The book will be especially valuable to toxicologists, vets and the owners/managers of commercial animals. Unfortunately, a price tag of almost $200 will place it out of the reach of many readers; but I hope it will find a way into many public libraries, where it will be of value to those who work frequently with plants, pet owners, foragers and parents, among others.

This is a big, heavy, hardcover book full of useful and interesting information. For example: grapes can be poisonous to dogs and just four cloves of garlic can kill a horse! No wonder it does such a good job of knocking over a cold. I think I will ease off a bit on the home remedies!

Australia's Poisonous Plants, Fungi and Cyanobacteria is available from CSIRO publishing in Australia, Stylus in the Americas and Eurospan in the rest of the world.

Daniela Brozek-Cordier, nghenvironmental, Bega, NSW.

Book reviews (cont.)



Life in a Gall
The Biology and Ecology of Insects that live in Plant Galls

by Rosalind Blanche
CSIRO Publishing, June 2012
80 pages with colour photographs and line art
Paperback, ISBN: 9780643106437
Price: AU $29.95
Available from: www.publish.csiro.au

Life in a Gall explores the fascinating world of Australian native plant deformities known as galls, and what causes different plant species to respond this way to the wide variety of Australian native gall-inducing agents which cause them. This book also explains how these insects locate the right plant to create their gall, then how they adapt to living inside a gall, including all the associated biological processes involved. The roles of attacking predators, parasitoids, kleptoparasites, inquilines and micro organisms on gall-inducing insects and the insect's defence responses are also discussed.

Following an introduction, Blanche has divided the book into chapters which examine the known types of gall-inducing insects, their host plants, the evolution of the insects to the enclosed environs of a gall, organisms which attack the insects, issues and benefits related to gall-inducing insects and how to approach the continued study and research of galls and their insects. Each chapter is further separated into sub-headings which highlight topics within each broader chapter, making the book easier to digest. This is followed by a concise list of further readings on associated topics and a scientific glossary.

Blanche states that over 50% of galls are found on Australian native *Eucalyptus, Corymbia* and *Angophora* species in the Myrtaceae family, while 18% are found on either Acacia species in the Mimosaceae family or *Ficus* species in the Moraceae family. Galls, therefore, are geographically widespread throughout Australia.

The chapter which examines the impacts associated with Australian native plants and gall-inducing insects (such as midges, psyllids and wasps) provides much interesting detail on Australian plant species affected by galls and the economic losses which result in reductions of certain food crops, commercial timber plantation yields and nursery trade production. These species include Scarlet Banksia (*Banksia coccinea*), Finger-lime (*Citrus australasica*), Magenta Cherry (*Syzygium paniculatum*), Lemon-scented Gum (*Corymbia citriodora*), Southern Blue Gum (*Eucalyptus globulus*), River Red Gum (*E. camaldulensis*) and Geraldton Wax (*Chamelaucium uncinatum*).

The role of gall deformities in the relationship between the critically endangered species Orange-bellied Parrot (*Neophema chrysogaster*) and its main food source the Beaded Glasswort (*Sarcocornia quinqueflora*) is also examined.

Benefits such as using gall-inducing insects as effective bio-control agents are discussed in a separate chapter, both in Australia with the weed species Coastal Tea Tree (*Leptospermum laevigatum*) and in controlling Australian natives which have established as weed species overseas.

The important role of pollinating Australian native figs (*Ficus* species) via gall-inducing fig wasps, and the fascinating processes associated with this mutualistic relationship is explored in some detail. These wasps and fig species are totally co-dependant, and neither species can reproduce without the other present.

Interesting examples of how gall-inducing insects provided bush tucker for Indigenous communities such as 'mulga apples' on Mulga (*Acacia aneura*) and 'bush coconuts' on *Corymbia* species are included.

The technical nature of this book is nicely balanced with more general information, making it accessible to a wide audience including working ecologists and consultants, entomologists, botanists, scientists and interested amateurs. The style of the book is easy to read, providing a mixture of evidence-based science with a more conversational tone while discussing different questions concerned with this subject. Blanche has included interesting facts such as the derivation of scientific terms and names, examples of current research projects in this field and inspiring new discoveries of unique galls and gall-inducing insects.

This book contains a diverse range of excellent and high quality photographs which capture the subject matter including a variety of galls, gall-inducing insects and organisms, host plants, the effects of galls on plants and how to study them, as well as illustrations such as flow charts. These provide a vibrant pathway which accompanies the text, making the concepts and information throughout this book easier to follow and understand.

This book provides a well-rounded and enjoyable journey through the complex and often bizarre microcosm of Australian native galls, the insects that cause them, their enemies and their various biological and ecological interactions.

Liz Brown, Eco Logical Australia Pty. Ltd., Coffs Harbour NSW

Information resources and useful websites

Wildlife and Climate Change: Towards robust conservation strategies for Australian fauna Proceedings of the Royal Zoological Society of NSW forum

Editors Dr Dan Lunney and Dr Pat Hutchings

http://rzsnsw.metapress.com/content/t128v7/?p=8ce8935a996b46db a0130a4e80d6d503&pi=5

The proceedings from the Royal Zoological Society of NSW recent annual forum, Wildlife and Climate Change: Towards robust conservation strategies for Australian fauna is now available free online. The book examines how wildlife responds to climate change and will have a major impact on climate change research and discussions in Australia and beyond.

Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)

http://www.ipbes.net/

Governments from more than 90 countries have agreed to establish an independent panel of scientists to assess the very latest research on the state of the planet's fragile ecosystems. The decision, which will create a body akin to the Intergovernmental Panel on Climate Change (IPCC), was made 21st April in Panama City, after years of negotiations.

The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) will be responsible for producing international scientific assessments on issues such as ocean acidification and pollination, to help policy makers to tackle the global loss of biodiversity and degradation of ecosystems.

More information can be found in:

an article in *Nature*: http://www.nature.com/news/world-governments-establish-biodiversity-panel-1.10505.

an article in a recent issue of *Decision Point* (page 12): http://www.decision-point.com.au/images/DPoint_files/Dpoint_61/dpoint_61.pdf.

A guide to the identification, assessment and management of Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia

Department of Sustainability, Environment, Water, Populations and Communities

http:// environment.gov.au/epbc/publications/grey-box-booklet.html

The Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia ecological community was listed in 2010, as endangered, under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This nationally threatened ecological community was once widespread inland, from central New South Wales, through Victoria, to eastern South Australia.

The illustrated booklet is designed to assist land managers, owners and occupiers as well as environmental assessment officers, consultants and the general public to identify, assess and manage the Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia.

This booklet accompanies the listing and conservation advice, which present the definitive and detailed description of this nationally threatened ecological community. The listing advice is a technical document that explains what an ecological community is, where it is known to occur, why it merits listing as nationally threatened and which conservation status applies to the ecological community. The conservation advice identifies priority management and conservation actions. The booklet presents some of this information in a consolidated and more accessible format, complete with identification flowcharts and photographs of the ecological community and its key species.

If you would like to obtain a hardcopy or multiple copies of this document, please contact the Department's Community Information Unit: telephone: 1800 803 772; email: ciu@environment.gov.au; mail: Community Information Unit, Department of Sustainability, Environment, Water, Population and Communities, GPO Box 787, Canberra, 2601.

All documents relating to this ecological community can be found in the Australian Government's species profile and threats database (SPRAT) at: www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl

Lowland Rainforest and Landholders factsheet

Department of Sustainability, Environment, Water, Population and Communities

http://www.environment.gov.au/epbc/publications/pubs/lowland-rainforest-and-landholders.pdf

The Lowland Rainforest of Subtropical Australia ecological community was once one of Australia's largest rainforests but, since European settlement, much of it has been cleared or degraded. The surviving remnants of the Lowland Rainforest ecological community provide vital habitat for many native species including threatened wildlife such as Coxen's fig-parrot and the red-legged pademelon. The extent of this Lowland Rainforest remaining in good condition is now protected under Australia's national environment law—the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Information resources and useful websites (cont.)

21 of Australia's most threatened plants

Australian Network of Plant Conservation
http://www.anpc.asn.au/21threatenedplants.html

The Australian Network for Plant Conservation (ANPC) is celebrating 21 years of promoting and developing plant conservation. To mark the occasion we've released a list of 21 of Australia's most threatened plants. The list was launched on National Threatened Species Day. National Threatened Species Day is held on 7 September each year - commemorating the death of the last Tasmanian tiger at Hobart Zoo in 1936.

National Threatened Species Day aims to raise awareness of the plight of threatened species and to encourage community involvement in their conservation.

The general public is typically aware that many of Australia's animals, like the Tasmanian Devil and the Hairy-nosed Wombat, are threatened with extinction. But they are often not aware that hundreds of Australian plant species face extinction.

More than 40 Australian Plant Species have become extinct since European settlement and over 1000 species are currently considered likely to become extinct within our lifetime unless something is done to reverse their decline

Help raise awareness of Australia's unique and threatened flora by sharing this list among your friends and networks.

A Celebration of Wattle Australia's National Emblem

by Maria Hitchcock
Rosenberg Publishing, August2012, 192 pages
Paperback, ISBN 9781921719561; AU $29.95

Wattle is the best known and most loved of all our native flora. However, few Australians are aware of the important part wattle has played in the nation's history and continues to play in bringing us together in good times and bad as a symbol of our being Australian.

A Celelebration of Wattle is a revised edition of 'Wattle' (AGPS 1991). It expands on that earlier book with some changes. New features include Wattle Day memories and a wealth of suggestions for schools and the community to help them celebrate future Wattle Days. There are additional poems in the anthology and special sections have been inserted outlining a brief history of the Wattle Day Association, the amazing story of the Hiroshima connection, an explanation of the botanical battle for Australia's retention of the name Acacia and a detailed summary of the debate about wattle and allergies. This edition is beautifully illustrated throughout with almost 200 photographs and watercolours of wattles as well as many archival photos.

Maria Hitchcock, known as the 'Wattle Lady', is a retired High School teacher who lives in Armidale, NSW. She holds a Masters with Honours degree in Aboriginal Studies and a BA with a major in Botany as well as other teaching qualifications. She has been an active environmentalist for over 40 years and is a Life Member of the Australian Plants Society. She is a garden writer, horticulturalist and landscape consultant. She is a passionate supporter of Wattle Day and is responsible for formal gazettal of *Acacia pycnantha* as our National Floral Emblem and National Wattle Day on September 1 each year. She continues to advocate for wider recognition of Wattle Day by both government and the Australian community.

Available from: http://www.rosenbergpub.com.au

Australian carnivorous plants

by Greg Bourke and Richard Nunn
Redfern Natural History Productions, August 2012, 180 pages
Hardcover, ISBN 9781908787026, AU $70

Australian Carnivorous Plants is a beautifully produced coffee table book with extensive colour photographs of all carnivorous plant genera found in Australia (*Aldrovanda, Byblis, Cephalotus, Drosera, Nepenthes*, and *Utricularia*). Incorporating 180 images of over 150 species taken over the past two decades by acclaimed wildlife photographers and carnivorous plant experts, Greg Bourke and Richard Nunn. The spectacular images and detailed captions, written in accessible English, offer a uniquely informative portrait of some of the Southern Hemisphere's most extraordinary and beautiful plants. It is a work that will fascinate amateur nature enthusiasts and specialist botanists alike. This beautiful book includes a foreword by Allen Lowrie, a world authority on carnivorous plants; a short introductory chapter to the carnivorous plants of the world with a summary and complete listing of all carnivorous plant species found in Australia; chapters dedicated to each genus of Australian carnivorous plant with introductory descriptions; a chapter on conservation; and information relating to the photographic techniques used by the authors. Many of the taxa covered here have never been depicted in print before.

Available from: http://www.redfernnaturalhistory.com/books

Information resources and useful websites (cont.)

Land use intensification: effects on agriculture, biodiversity and ecological processes

Edited by David Lindenmayer, Saul Cunningham and Andrew Young
CSIRO publishing, July 2012, 168 pages
Paperback, ISBN: 9780643104075; AU $49.95

There can be little doubt that there are truly colossal challenges associated with providing food, fibre and energy for an expanding world population without further accelerating already rapid rates of biodiversity loss and undermining the ecosystem processes on which we all depend. These challenges are further complicated by rapid changes in climate and its additional direct impacts on agriculture, biodiversity and ecological processes.

There are many different viewpoints about the best way to deal with the myriad issues associated with land use intensification and this book canvasses a number of these from different parts of the tropical and temperate world. Chapters focus on whether science can suggest new and improved approaches to reducing the conflict between productive land use and biodiversity conservation.

Who should read this book? Policy makers in regional, state and federal governments, as well as scientists and the interested lay public. Available as a paperback or eBook from http://www.publish.csiro.au/pid/6808.htm

Research Roundup

Compiled by Kirsten Cowley, Centre for Plant Biodiversity Research, Canberra.
Email: Kirsten.Cowley @csiro.au

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Contributions to Research Roundup are welcome, and should be sent to Kirsten Cowley at the above email address using an email subject heading "APC Research Roundup" or similar. Their inclusion will be subject to available space.

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Australian Network for Plant Conservation
presents a workshop on

Seed collection, storage and use for native vegetation restoration

5 November 2012, The Australian Botanic Garden, Mount Annan NSW
3 April 2013, University of the Sunshine Coast, QLD

This workshop will provide participants with the knowledge needed to effectively collect, store and use seed in native vegetation restoration.

Experts in the use of native seed will present a selection of case studies.

Topics covered include:

- developing a collection strategy
- seed collection methods
- pest and disease management
- seed banking
- seed germination & dormancy

The Royal
Botanic Gardens
& Domain Trust

Australian
SEEDBANK
PARTNERSHIP

Australian Network for Plant Conservation
presents a workshop on

Translocation of threatened plants

6 and 7 November 2012, The Australian Botanic Garden, Mount Annan NSW
4 and 5 April 2013, University of the Sunshine Coast, QLD

This two day workshop will provide participants with the knowledge required to effectively plan, implement and evaluate translocation projects for threatened flora.

The workshop will include case studies of translocation programs, highlighting lessons to be learnt and also full-day field trip to translocation recipient sites for a range of threatened plants.

Questions addressed include:

- When is it appropriate to use translocation as a tool to conserve threatened species?
- What needs to be done when planning a translocation program?
- How should a translocation program be implemented?
- What ongoing management and evaluation is required?

Australian Network for Plant Conservation
presents a workshop on

Jewels in the Landscape

Managing significant native vegetation remnants

20 and 21 November 2012, Moree NSW

The workshop will provide participants with the skills required to plan, implement and monitor a project to manage and restore grassy woodland remnants.

Learning will be through a combination of theory presentations and field-based activities.

Topics to be covered include:

- ecology of grassy woodlands;
- weeds and weed management in grassy woodlands;
- grassy woodland restoration – what do we know?;
- grazing for biodiversity;
- planning a management and restoration project;
- flora identification skills;
- identifying the natural values of a site and its threats;
- identifying vegetation community type;
- vegetation monitoring techniques; and
- where to get help.

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Please visit **www.anpc.asn.au/courses.html** for more information and to register.

Australian Network for
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